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ABSTRACT

Part of a series of eight student learning modules in vocational agriculture, this booklet deals with animal reproduction and breeding. The topics covered are genetics, animal reproduction, breeding methods, artificial insemination, pregnancy diagnosis, and parturition care. Each section ends with a glossary and a quiz. (PLB)

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V.A. III
II-A-1

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STUDENT MATERIALS
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GENETICS.

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1. INTRODUCTION TO GENETICS

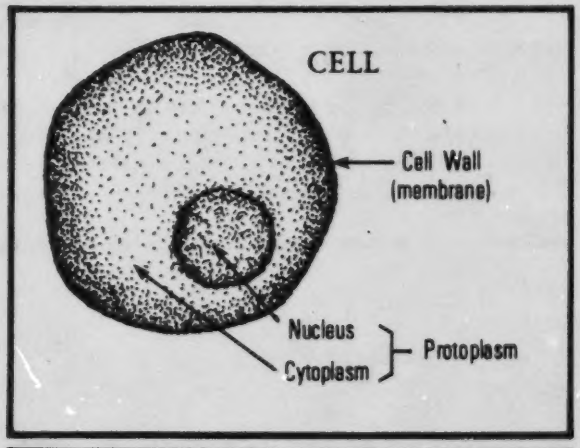
Genetics has been described as a study which deals with the differences and similarities among individuals related by descent. Individual differences within given species of plants and animals were noticed in very early times. It was determined that the selecting of seeds and animals for more desirable *traits improved both plants and animals. In the 18th century, man realized that like begets like and established breeding programs. The wide range of traits found in livestock today was developed by selection and breeding.

The process of inheritance was discovered by George Mendel, a monk and untrained scientist, while pursuing his hobby of breeding peas. However, his work was not recognized until in 1900 when his findings were duplicated by Conners, deVries, and Von Tschemals.

A knowledge of genetics is important to the livestock producer. Through the use of knowledge, selection, and breeding, the producer can develop animals with traits that make them more desirable to the consumer, increase production, and change physical appearance and temperament. The producer, however, must be aware that environment also affects many of the traits found in animals.

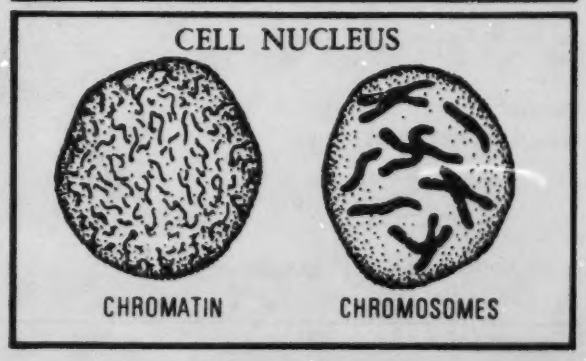
2. THE CELL AND CELL DIVISION

The body of an animal is made up of millions of tiny structural units called cells. Some cells are so small that if laid side by side 250,000 would be required to measure one inch. Because of their size, cells cannot be seen with the unaided eye and must be studied under a microscope. Most animal life starts with a single, fertilized cell. The cell is the basis for improving animals and has many different shapes.



A cell is composed of protoplasm and a cell wall. There are two parts of the protoplasm, the cytoplasm and nucleus. Cytoplasm gives the cell its shape, while the nucleus contains chromatin. Chromatin forms bodies called chromosomes, which carry minute cells called genes. Genes determine the hereditary characteristics of animals and are transmitted to the offspring from the parents.

Animals of the same specie have the same number of chromosomes, and the chromosomes contain millions of genes. It is because of the large number of genes and possible combinations of genes that no two animals are exactly alike.

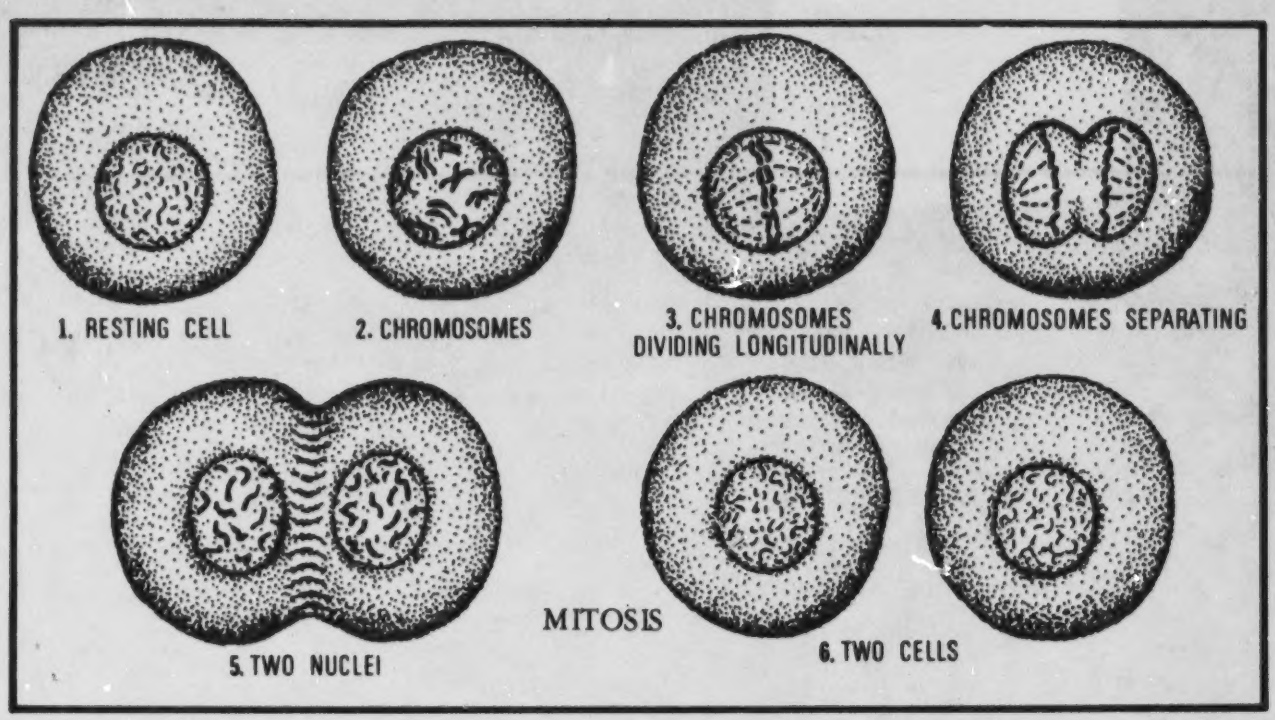


The numbers of chromosomes found in the cells of some animals are as follows:

Swine	80	Cattle	60	Sheep	54
Horse	60	Goat	60	Man	46

Animal growth is caused by cell division, rather than cell enlargement. As cells divide, the animal increases (grows) in size. A single cell divides into two cells. These two cells divide into four cells, and so on until an animal becomes an adult. The division of cells is called mitosis. The following illustrations give an example of cell division.

*All underlined terms are in the Glossary of Terms.

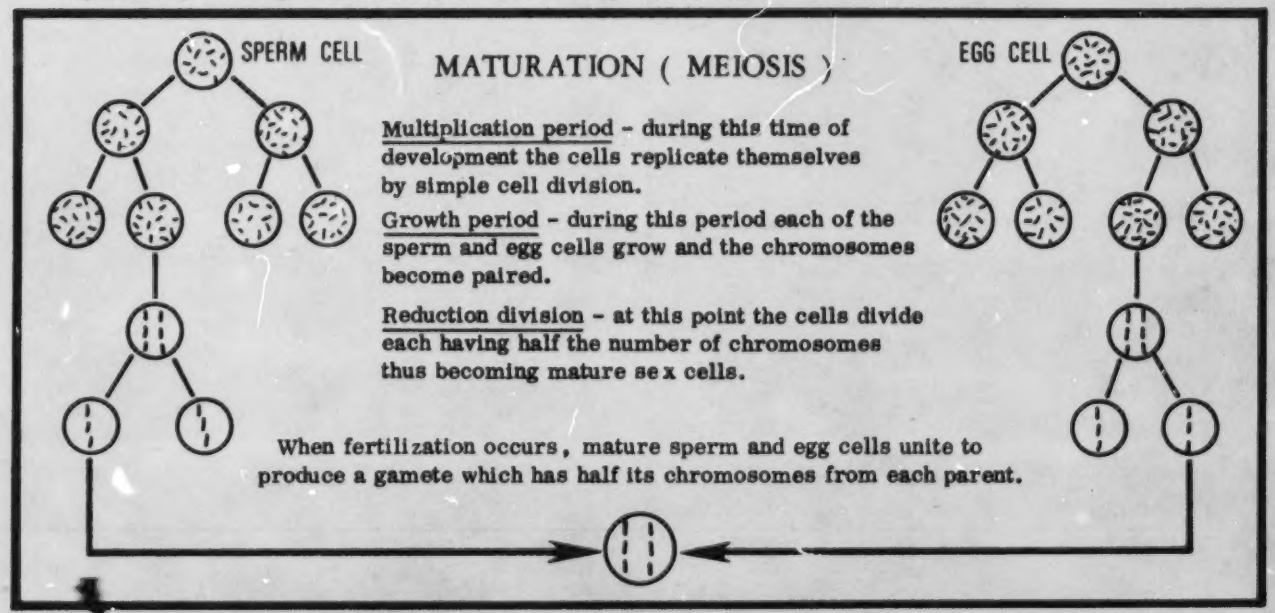


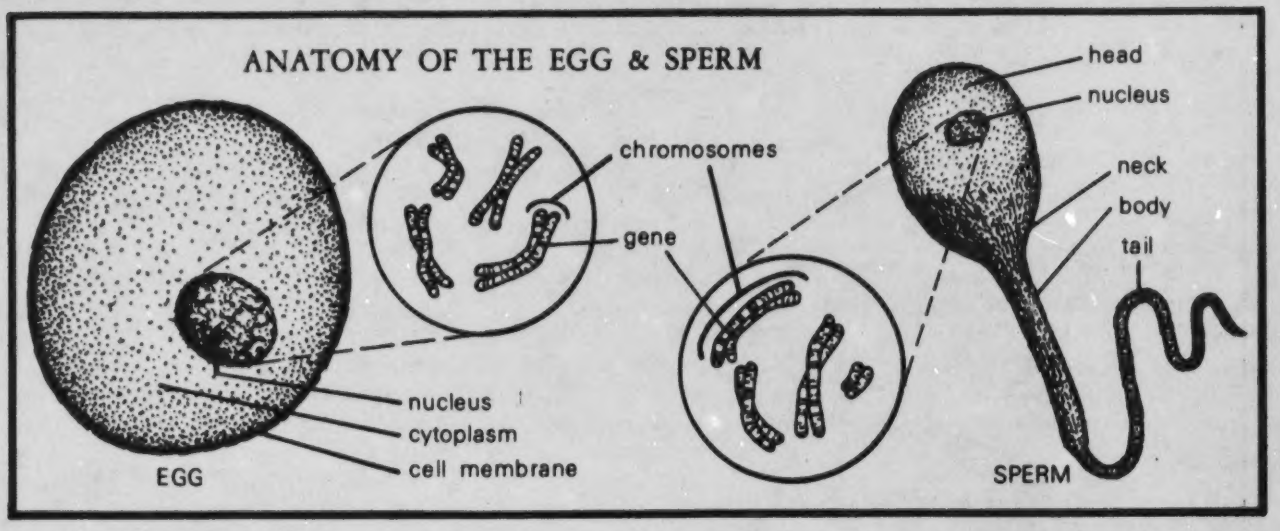
3. REPRODUCTION METHODS

Sexual and asexual are the two usual methods of reproduction. All domestic animals reproduce by sexual reproduction, which involves the union of a sperm and egg. Some plants may be reproduced by asexual reproduction. This is performed by cell division.

Cells from which animals are produced are called germ-cells or gametes. Male germ-cells are referred to as sperms or spermatozoa. Egg or ova are the terms used when reference is made to female germ-cells.

Both male and female germ-cells go through a process called maturation (meiosis) before uniting. During the maturation process, the chromosomes in the male and female germ-cells are reduced to one-half of the original number. There is one principal difference between the maturation of the male and female germ-cells. Only one in four of the female germ-cells is functional, while in the male all are functional and capable of producing a new individual after uniting with an egg.


SPERM CELL
MATURATION (MEIOSIS)
EGG CELL
Multiplication period - during this time of development the cells replicate themselves by simple cell division.
Growth period - during this period each of the sperm and egg cells grow and the chromosomes become paired.
Reduction division - at this point the cells divide each having half the number of chromosomes thus becoming mature sex cells.
When fertilization occurs, mature sperm and egg cells unite to produce a gamete which has half its chromosomes from each parent.



4. THE SPERM AND EGG

The sperm is very small and must be magnified many times before it is visible. Factors such as sexual use, health of male, season of the year, age of male, and specie affect the number of sperms and volume of semen produced. Using sperm concentration per service as a basis, farm animals would be ranked in the following order: rooster, bull, ram, boar, and stallion. Using volume of semen per animal as a basis, the ranking would be the boar, stallion, bull, ram, and rooster. The number of sperm cells in a single service is in the millions.

The reason the egg is much larger than the sperm is that it contains the food materials for the developing young. Some eggs are as large as 1/135 of an inch in diameter. The sperm and egg transmit all the characters that the offspring will inherit.

An indication of the number of eggs produced by a specie is the number of offsprings produced. For example, a sow may produce eight to ten pigs or even more, while a cow normally produces one offspring. All of the eggs produced by an animal are not fertilized.

A fertilized egg sometimes will separate into two parts, with each part forming an individual. Individuals being formed in this manner are of the same sex, have similar features, and are called identical twins. Twins developed from separate fertilized eggs are fraternal twins and are not identical.

When the spermatozoa and egg unite, fertilization takes place. This restores the original number of chromosomes which was reduced one-half in the maturation process.

5. DOMINANT AND RECESSIVE CHARACTERISTICS

A trait such as horns in cattle and hair color in horses is referred to as a character. Characters are not present in cells, but there is "something" present which produces the character. That "something" is known as a factor or gene. The development of all characteristics is conditioned by the presence of genes, but some are modified by differences in environment. The presence of some genes hides the presence of other genes. For example, both polled and horned genes may be present in cattle; but only the polled condition will be in evidence.

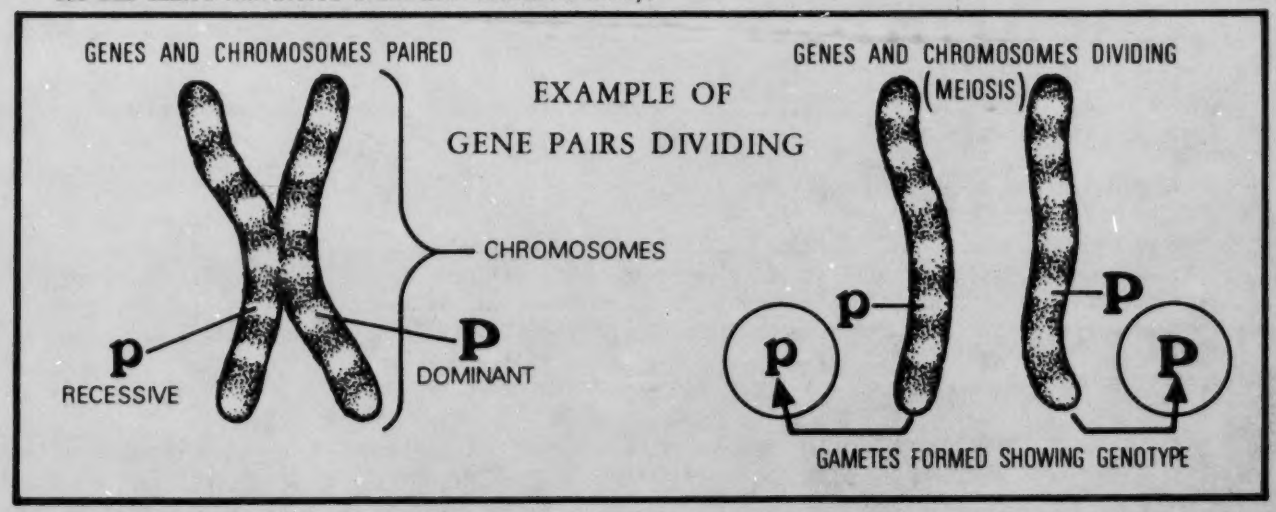
Genes that hide the presence of others are said to be dominant. Capital letters are used to designate (P for polled) dominant genes. Recessive genes are designated by small letters (p for horned). An individual having two genes for a character is said to be pure or homozygous for that character. Individuals with two different genes which affect a character differently are said to be impure or heterozygous for that character. The term purebred, used to refer to animals eligible for registration in a breed association, should not be confused with the term "homozygous." Purebred animals are normally heterozygous for many genes.

A list of some dominant and recessive factors is given below:

Dominant	Recessive
Poultry	
Rose Comb	Single Comb
White Shanks and Skin	Yellow Shanks and Skin
Feathered Shanks	Clean Legged
Black Plumage	White Plumage
Cattle	
Normal Size	Dwarf
Black Body	Red Body
White Face	Black Face
Polled	Horned
Dark Color	Light Color
Sheep	
Polled	Horned
White Fleece	Black Fleece
Swine	
Lopped Ears	Fox Ears
Mule Foot	Normal Foot
White Hair	Red and Black Hairs
Horses	
Black Color	Chestnut
Gray Color	

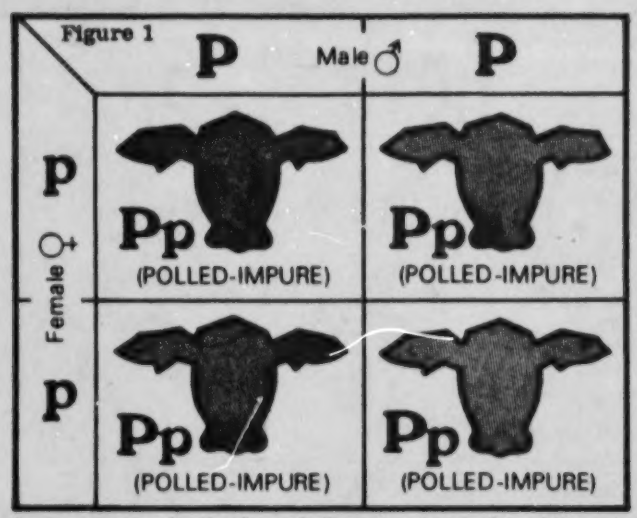
6. TRANSMISSION OF CHARACTERS

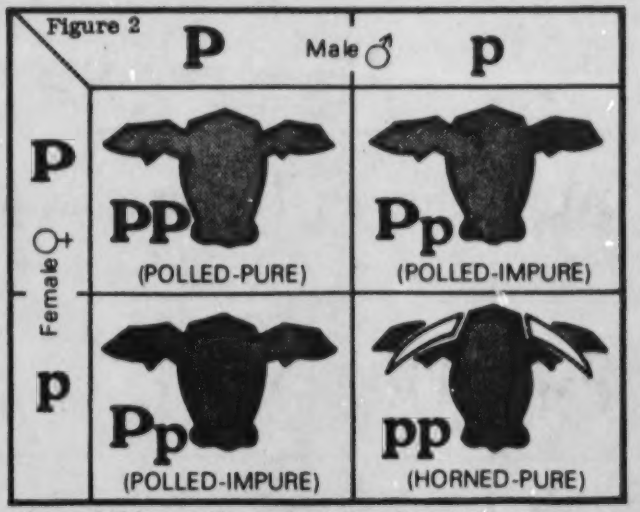
A homozygous character for polled is written PP, and the heterozygous character is written Pp. As previously stated, the number of chromosomes in both the male and female germ-cells is reduced to one-half the original number. During the maturation process, the genes separate and go to different gametes. After maturation only a single gene for a character is present in the reproductive cell, even though two genes for that character are always present in the fertilized egg or in the body cells of an individual (except for sex-linked characters which are discussed later).



The above illustration shows two genes, representing the polled character in cattle (PP or Pp), dividing during the maturation process. Genes P and p are known as alleles.

When recessive and dominant genes are united in the F1 generation, the dominant characters are carried by the progeny. Some of the animals in the F2 generation will show dominant characters, while others will show recessive characters.





A square or checkerboard diagram is used to determine the probable results in breeding livestock. The male germ-cells are normally indicated at the top (P and P), and the female germ-cells are indicated in the vertical margin (p and p). A cross between a male animal with a homozygous character for horned condition (pp) will produce only polled offsprings in the F1s (Figure 1).

As shown in Figure 2, the offsprings from individuals heterozygous for the polled character (Pp) will be in the approximate ratio of three polled to one horned; however, this is influenced by chance. The horned individual produced from the cross (lower right-hand block) will not carry a gene for the polled character even though both parents were polled.

To determine if a polled bull is homozygous for the polled character, the bull should be bred to horned cows. If he is pure, his offsprings will be polled. The above information may also be used to determine whether animals are homozygous or heterozygous for other characters.

A character can also be the result of incomplete dominance. Roan color in Shorthorn cattle is result of incomplete dominance of red and white. In this case, capital letters are used to designate each gene (R = red; W = white).

Figure 1.

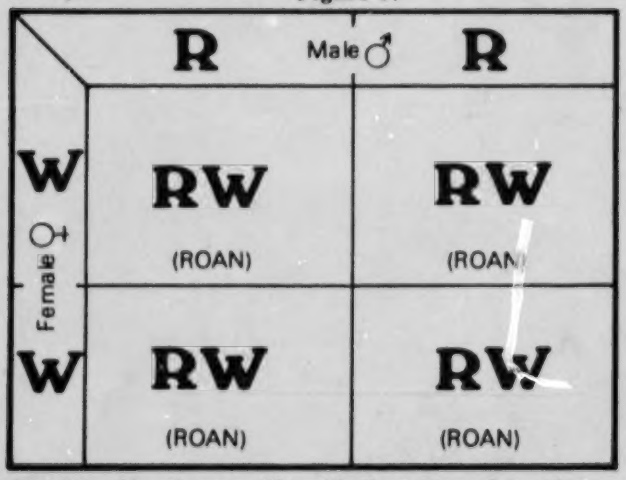
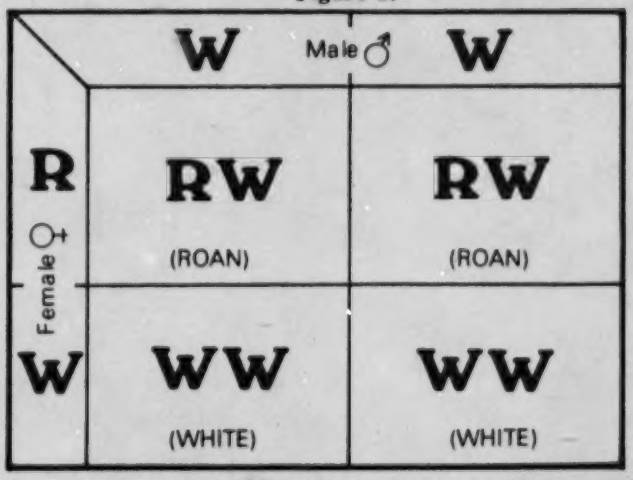


Figure 2.

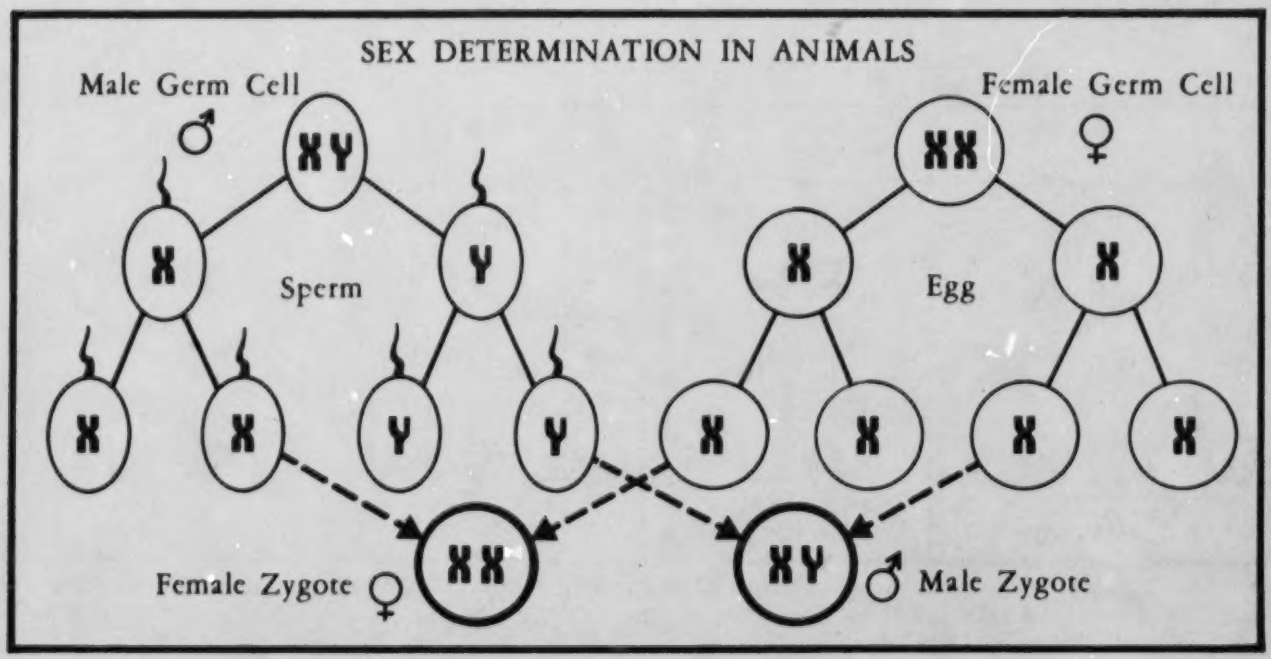


Breeding Shorthorn cattle with characters for color as shown in Figure 1 would produce offsprings which are all roan. The crossing of roan and white individuals as shown in Figure 2 would produce offsprings in the approximate proportion of two roan and two white.

Only single characters have been considered up to this point. There are a number of characters to be considered in any cross. One can expect a ratio of 3:1 based on appearance in the offsprings of a cross between individuals heterozygous for a dominant character. With two pairs of heterozygous characters a 9:3:3:1 (see following illustration) would be expected. With each additional character, the ratio is changed to the extent of multiplying the preceding ratio by 3:1.

Female ♀ \ Male ♂	PW	Pw	pW	pw
PW	PPWW (polled, whitefaced)	PPWw (polled, whitefaced)	PpWW (polled, whitefaced)	PpWw (polled, whitefaced)
Pw	PPWw (polled, whitefaced)	PPww (polled, coloredfaced)	PpWw (polled, whitefaced)	Ppww (polled, coloredfaced)
pW	PpWW (polled, whitefaced)	PpWw (polled, whitefaced)	ppWW (horned, whitefaced)	ppWw (horned, whitefaced)
pw	PpWw (polled, whitefaced)	Ppww (polled, coloredfaced)	ppWw (horned, whitefaced)	ppww (horned, coloredfaced)

Crosses between individuals impure for both horned and whitefaced conditions (Pp Ww) should give a ratio of nine polled whiteface, three polled colored faced, three horned whitefaced, and one horned colored faced. From this, one can see that to improve a particular character in breeding animals is complicated.



7. SEX DETERMINATION

Sex of an animal is determined at the time of fertilization. In addition to the regular chromosomes, the female has two sex chromosomes. These are designated by the letters XX. In the male only one sex chromosome (X) is present, and the other chromosome is designated with the letter Y.

After maturation, one-half of the sperms and all of the eggs carry an X chromosome. The other one-half of the sperms carry a Y chromosome. If in fertilization a sperm carrying an X chromosome unites with an egg, the offspring will be a female (XX). If a sperm carrying a Y chromosome unites with an egg, the offspring will be a male (XY).

In poultry the male carries two sex chromosomes, while the female carries only one. These are usually referred to by the letters Z and W. The letter W is used to indicate the sex chromosome in the female. Thus, the male would be designated as ZZ and the female as ZW. After maturation all of the sperms carry a Z chromosome, but only one-half of the eggs would carry Z. The square explained earlier may be used to determine the sex.

8. SEX-LINKED CHARACTERS, CROSSING-OVER, AND MUTATION

Certain genes located on the X or Z chromosomes are referred to as sex-linked. These characters may be used to determine the sex of an animal. For example, the barring of Barred Plymouth Rock chickens is a sex-linked character. If barred hens are mated to nonbarred males, all the barred chicks from this cross are males (ZBZb), and the nonbarred chicks are females (ZbW). There are other sex-linked characters.

In some cases there is an interchange of the entire segment of certain chromosomes as a result of crossing-over.

Ocassionally, something will change a gene, and an individual is produced with a new character, a mutation.

9. IMPROVING BY SELECTION

Permanent improvements in livestock are usually the result of selection. The two kinds of selection are natural and artificial. Natural selection is the selection made by wild animals. Artificial selection is the selection made by man. Environment, recombination of characters, and mutation are factors which cause variations in animals bred by artificial selection.

Climate, amount and kinds of feed available, and methods of feeding are environmental factors that can cause variations in animals. Animal selection should be based on factors not influenced by the environment.

A major cause of difference in animals is a recombination of characters. These differences are caused by the production of germ-cells with different characters. Selection based on these differences is permanent and is the best means of improving animals.

Another cause of variation among animals is a mutation. Selection based on a mutation is permanent. However, most mutations are not beneficial and progress is slow.

A detailed discussion of various methods of selection may be found in other V.A. III Animal Science student materials.

GLOSSARY OF TERMS

1. Asexual - A method of reproduction performed by the division of a single cell.
2. Crossing Over - The interchange of the entire segment of chromosomes.
3. Dominant - Refers to genes which hide or mask the presence of other genes.
4. F1 Generation - In these materials, the term refers to the first generation or offspring(s) from the mating of two animals.
5. Genes - That "something" in reproductive cells that gives rise to a character and determine the hereditary characteristics of animals.
6. Germ-Cells - Cells from which new individuals are produced.

7. Heterozygous - An animal that carries genes which affect a character differently (impure).

8. Homozygous - An animal that carries genes for the same character (pure).

9. Identical Twins - Two animals of the same sex which developed from a single fertilized egg.

10. Incomplete Dominance - Neither character is dominant.

11. Maturation - The process of maturing.

12. Mitosis - The division of cells.

13. Mutation - An unexplained genetic change in animals that is hereditary.

14. Recessive Genes - Genes that appear when dominant characters are not present.

15. Semen - A whitish fluid containing spermatozoa.

16. Sex-Linked - Characters developed from genes located on sex chromosomes. The character may be used to determine the sex of an animal. Barring of Barred Plymouth Rock chickens is an example.

17. Sexual - A method of reproduction which involves the union of a sperm and an egg.

18. Trait - Characteristic which may be either inherited or caused by a mutation.

SELECTED STUDENT ACTIVITIES

1. List three environmental factors that can cause variations in animals.
   a.
   b.
   c.

2. What are the kinds of selection?
   a.
   b.

3. What is the major cause of differences in animals?

4. Explain how sex-linked characters may be used to determine sex.

5. When is the sex of an animal determined?

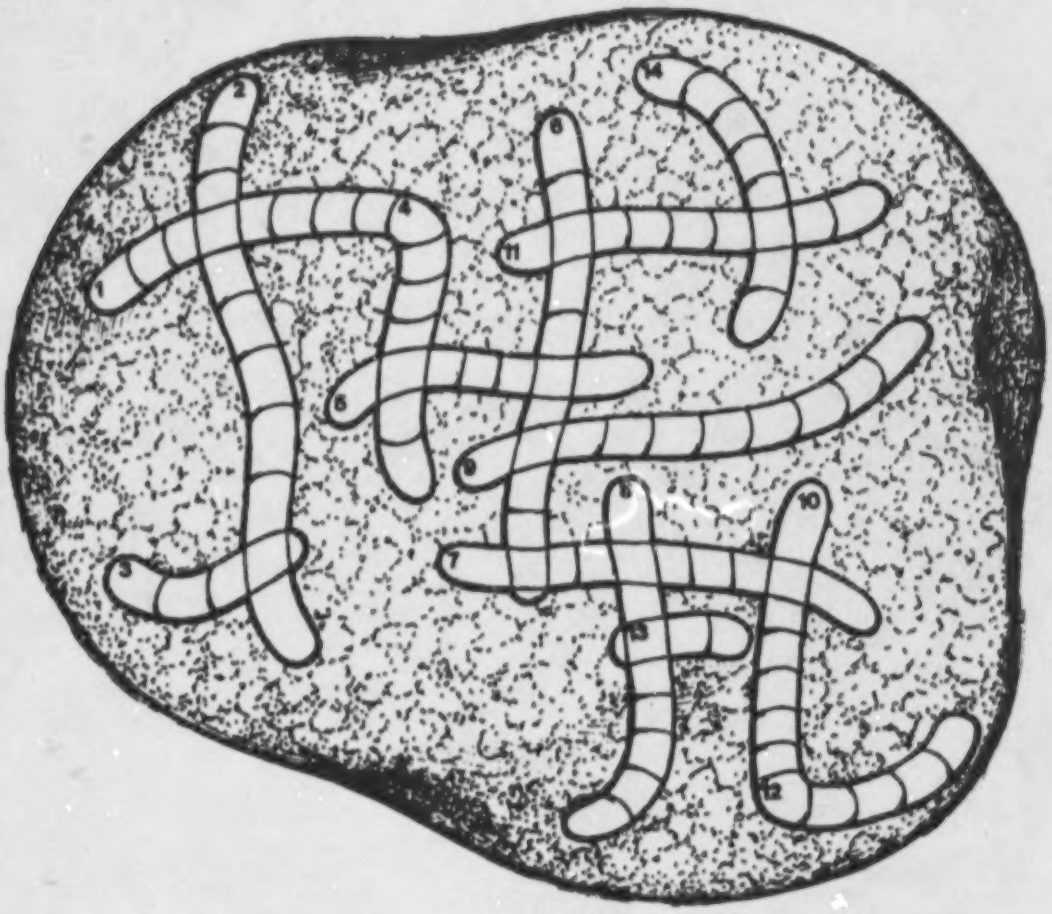
6. Explain how one might determine if a character is homozygous (pure).

7. An indication of the number of eggs produced by a specie is the _____ of _____ produced.

8. Why are eggs much larger than the sperm?

9. How would the following farm animals rank using sperm concentration as a basis? Stallion, Boar, Bull, Rooster, Ram.

10. Crossword Puzzle



Across:

1. _____ gives the cell its shape.
3. Minute cells carried by chromosomes and determine hereditary characteristics.
5. A method of reproduction.
7. A process in which the male and female germ cells develop.
9. A term used when an individual has two genes for a character.
11. A gene that is hidden by another gene.
13. The number of sex chromosomes carried by poultry males.

Down:

2. Bodies formed from chromatin.
4. Cell division is called _____.
6. A male germ cell.
8. Twins developing from separate fertilized eggs.
10. A gene that hides the presence of another gene.
12. A characteristic or _____.
14. An unexplained variation in animals.

10

NOTES

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ANIMAL REPRODUCTION

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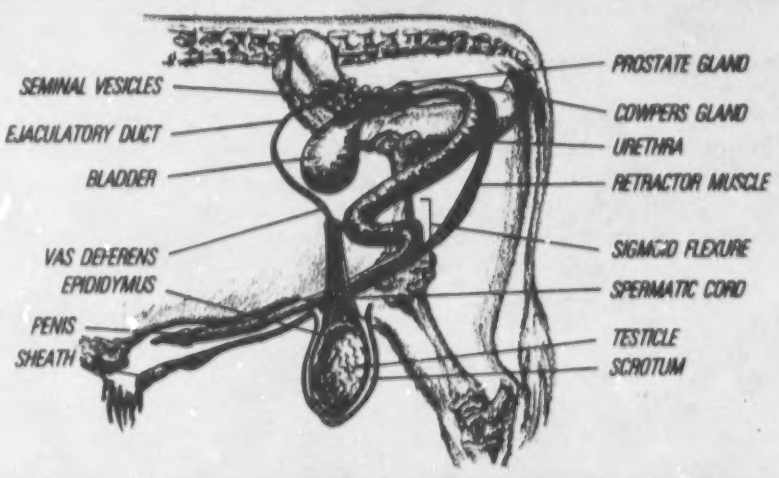
1. INTRODUCTION TO ANIMAL REPRODUCTION

"Reproduction" is the process of producing offspring for the purpose of continuing a species. The process begins with the mating of a male and female of the species. During copulation* the male sperm cell (spermatozoa) is deposited in the female reproductive tract where it eventually unites with the female egg cell (ovum) to form the embryo. The embryo then attaches to the wall of the female reproductive tract, becomes a fetus where it is protected, receives nourishment and develops until parturition.

2. ANATOMY AND FUNCTIONS OF THE MALE REPRODUCTIVE SYSTEM

The major function of the male reproductive system is the production, storage and deposition of sperm cells. It also functions in the production of certain male sex hormones, and as a passageway for the expellation of urine from the bladder. The male reproductive tract is made up of several organs, glands, and muscles, each having a special function. The testes produce sperm cells and the male sex hormone testosterone. Testosterone causes secondary male characteristics and libido. The testes are suspended from the body in the scrotum, which serves to protect and maintain the temperature of the testes about 5° below the body temperature, which is necessary for the sperm to live.

MALE REPRODUCTIVE SYSTEM



The epididymis is a long, greatly coiled tube connected to each testicle which serves in the maturation, storage, and transportation of sperm cells. The vas deferens (sperm duct) originates from the epididymis and serves as a passageway for sperm to the urethra. The vas deferens is included in the spermatic cord which is a protective fibrous sheath consisting of smooth muscles, blood vessels, and nerves. The seminal vesicles are paired accessory glands which secrete seminal fluid that functions as a protection and transportation medium for the sperm. The prostate gland secretes a thick milky fluid that mixes with the seminal fluid and provides nutrition and substance to the ejaculate. Just prior to ejaculation, the Cowper's gland secretes a fluid, similar to the seminal fluid, which cleanses and neutralizes the urethra. The urethra is the passageway or tube which extends from the bladder to the end of the penis and serves as the transportation route for the semen and urine. Semen or ejaculate are terms given the sperm plus the added accessory fluids of the seminal vesicles and the prostate. The penis is the organ which allows for depositing the semen

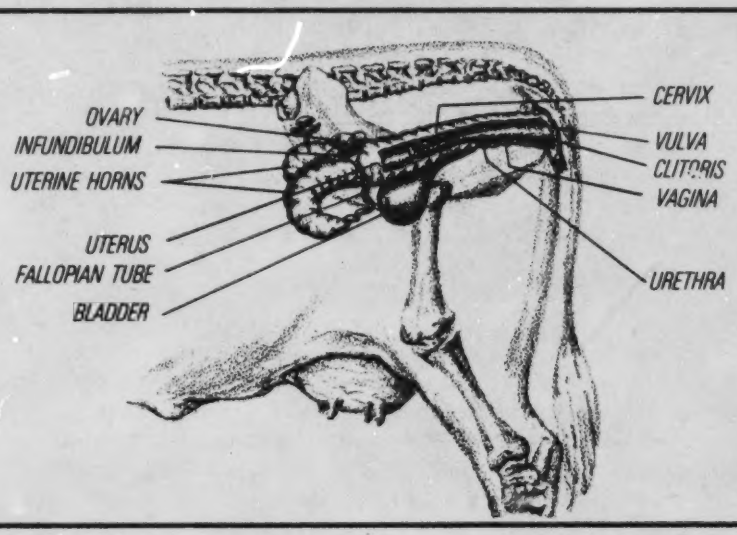
*Underlined terms are in the Glossary of Terms.

in the female reproductive tract. The sheath is the external portion of the male reproductive tract which serves to protect the penis.

3. ANATOMY AND FUNCTION OF THE FEMALE REPRODUCTIVE SYSTEM

The purpose of the female reproductive system is to produce the eggs or ovum to be fertilized by the sperm to form the embryo. It serves as a receptacle for the penis during copulation and houses and nourishes the fetus until parturition. There are two ovaries which function to produce eggs or ovum in numerous follicles and produce the female hormones estrogen and progesterone.

FEMALE REPRODUCTIVE SYSTEM

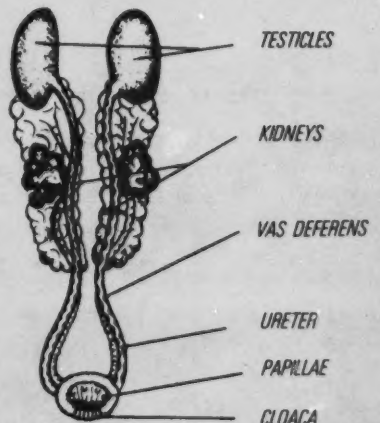


Just below the ovaries there are two funnel-like openings to the oviducts called the infundibulums which pick up the eggs at ovulation and direct them into the fallopian tubes, which is a passageway for the eggs into the uterine horns. The uterine horns is where the embryo usually attaches to the uterine wall, where it is nourished and develops until parturition. The body of the uterus is where the horns join, and it is separated from the vagina by the cervix. The cervix is a mass of concentric muscles with a small tube-like opening which joins the uterus and the vagina. It serves as a passageway for the semen from the vagina to the uterus at copulation. It also contains glands which secrete a waxy-like substance which seals off the uterus during pregnancy and between heat periods to protect against infection, disease, or foreign matter. The vagina is a receptacle for the penis during copulation. It also serves as a passageway for the expellation of liquid wastes, as the urethra joins the bladder to the vagina prior to the opening at the vulva. Just inside the vulva is a sensory erectile organ called the clitoris. The vulva is the exterior opening of the reproductive and urinary tracts.

4. ANATOMY AND FUNCTION OF MALE REPRODUCTIVE SYSTEM IN POULTRY

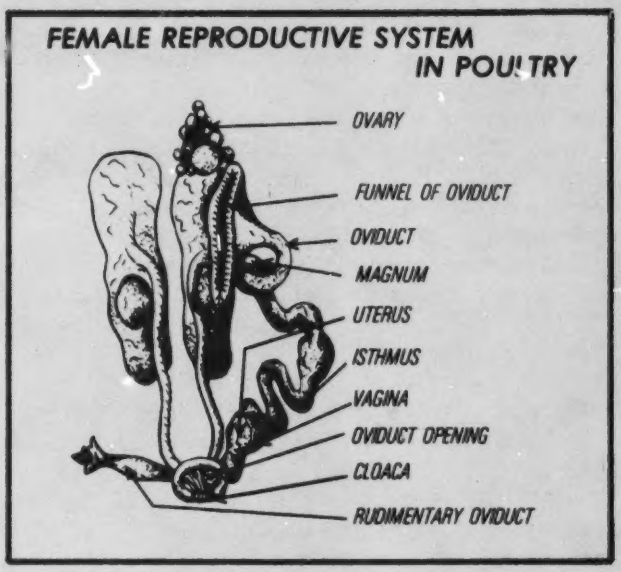
In poultry the testes of the male are located internally. The sperm cells are produced and carried out of the testes by the seminal fluid which is also produced by the testes. The vas deferens are the two tubes which carry the sperm from the testes to the cloaca. The papillae are rudimentary copulatory organs located in the cloacal wall. During mating or copulation the sperm is passed from the papillae into the oviduct opening in the cloacal wall of the female.

MALE REPRODUCTIVE SYSTEM IN POULTRY



5. ANATOMY AND FUNCTION OF FEMALE REPRODUCTIVE SYSTEM IN POULTRY

The female reproductive system actually consists of the ovaries and oviducts. Before the bird reaches maturity the right ovary and oviduct degenerate and never function. The ovary appears as a cluster of tiny gray yolks or ova (ovum). The oviduct is a long glandular tube that extends from the ovary to the cloaca and consists of five parts. The funnel or infundibulum which receives the yolk from the ovary is the first part. The second part is the magnum which secretes the thick albumen or white. Third, the isthmus adds the shell membrane. Then fourth, the uterus secretes the thin white, the shell, and the shell pigment. Last is the vagina which holds the egg until it is laid. The egg passes from the oviduct to the cloaca and then out of the body through the vent at the time of laying.



6. THE REPRODUCTIVE PROCESS IN MAMMALS

The estrous cycle is the period of time from the beginning of one heat period (estrus) to the beginning of the next. This time differs among the various species of livestock. For example, it is from 18 to 25 days in cattle, averaging 21 days. The estrous cycle begins with the ripening or maturing of a follicle on an ovary in a non-pregnant female. At this time the follicle containing the maturing egg secretes the hormone estrogen which begins the heat period (the time the female will accept a male). The length of the heat period is also determined by the species of animal. At some point during heat, or shortly after, the follicle will erupt; this is known as ovulation. After ovulation has occurred the follicle that erupted becomes a depression on the ovary known as a corpus luteum and secretes the hormone progesterone. This causes the absence of heat until the next follicle matures completing an estrous cycle.

After ovulation has occurred the egg or ovum is received by the nearest infundibulum and funneled into the oviduct. If the female has been bred during the heat period and a viable sperm reaches the oviduct and fertilizes the egg then pregnancy occurs. If fertilization occurs, the corpus luteum persists on the ovary and produces progesterone through pregnancy so that a heat period does not occur until after the pregnancy has terminated. The hormone progesterone also helps implant and nourish the embryo and develop the mammary system.

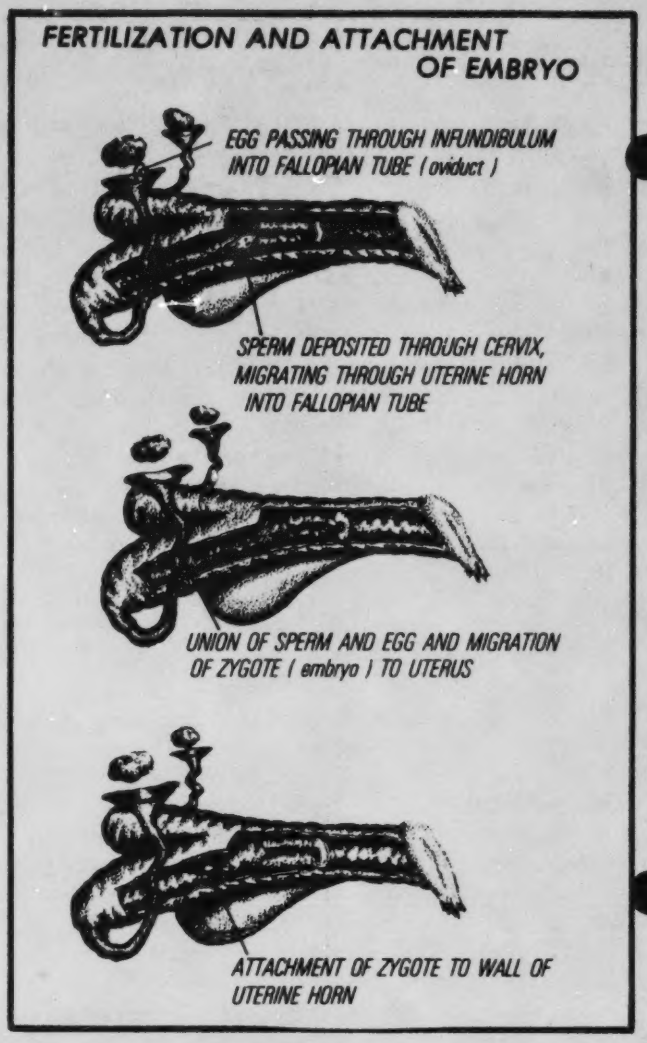
Fertilization is the union of the sperm and the egg and is the actual beginning of pregnancy. During the heat period the female is either bred naturally or inseminated artificially. At this time the semen containing the sperm is deposited into the vagina of the female. The sperm make their way through the cervix into the uterus, then up into one or both horns of the uterus, and finally into the oviducts. If the sperm were deposited into the reproductive tract at the proper time in relation to ovulation the sperm and egg will unite and fertilization will occur.

The fertilized egg or zygote begins a process of division and becomes an embryo. The embryo actually

floats freely in the uterus where it obtains its nourishment from the fluids secreted by the uterine walls. After about thirty-five days in cattle (this period differs with each species of livestock), the embryo will attach to the wall of the uterus where it becomes a fetus. The embryo is encompassed in a fluid filled membrane called the embryonic vesicle, which develops raised button-like nodules on its surface called caruncles. At the time of attachment to the uterus these nodules attach themselves to raised prominences in the uterine wall called cotyledons. During fetal development the fetus is fed by the mother through these attachments.

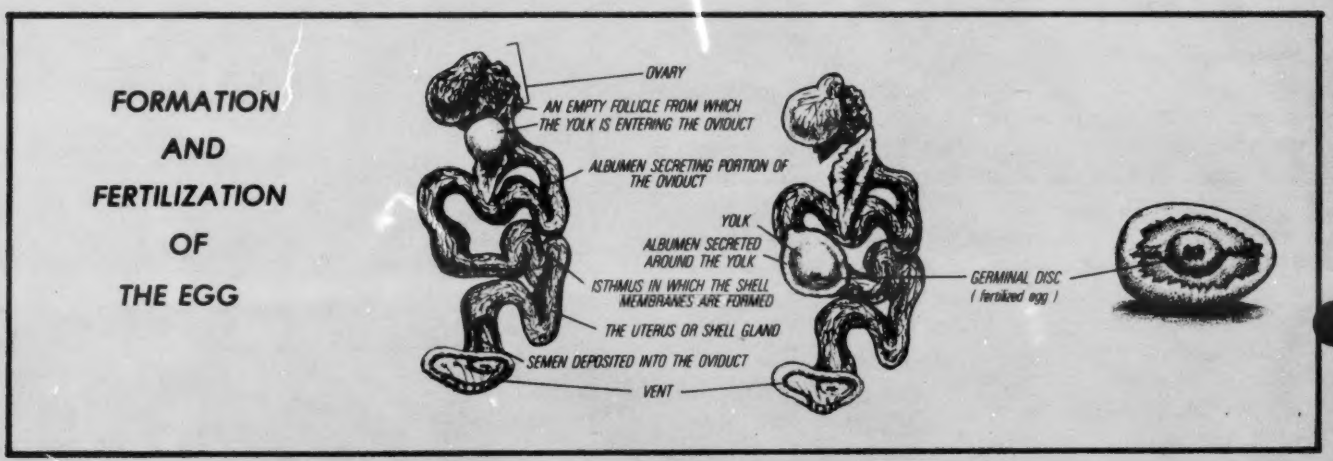
In some species of mammals several eggs are produced and fertilized during a single heat period resulting in multiple births. If two or more eggs are fertilized, the resulting offspring are called fraternal twins or siblings and are no more genetically alike than are full brothers and sisters resulting from single births. Sometimes two offspring are produced from a single egg fertilized by a single sperm resulting in maternal or identical twins.

A normal pregnancy is terminated by birth. At the time of parturition the fetus is expelled from the uterus and passes through the cervix and vagina out of the reproductive tract. The caruncles of the placenta detach from the cotyledons of the uterus, and it is also expelled at birth. After parturition the corpus luteum on the ovary begins to regress, decreasing the production of progesterone. At this time another follicle will begin to develop on one of the ovaries and heat will occur at its maturity.


FERTILIZATION AND ATTACHMENT OF EMBRYO
EGG PASSING THROUGH INFUNDIBULUM INTO FALLOPIAN TUBE (oviduct)
SPERM DEPOSITED THROUGH CERVIX, MIGRATING THROUGH UTERINE HORN INTO FALLOPIAN TUBE
UNION OF SPERM AND EGG AND MIGRATION OF ZYGOTE (embryo) TO UTERUS
ATTACHMENT OF ZYGOTE TO WALL OF UTERINE HORN

7. THE REPRODUCTIVE PROCESS IN POULTRY

Sperm are introduced into the oviduct in the cloacal wall of the female by the papillae in the wall of the male. The sperm move up the oviduct to the funnel of the oviduct where fertilization takes place. It is possible for fertile eggs to be produced within 24 hours after mating. Sperm cells will remain in the oviduct for 2 to 3 weeks, retaining their full viability for about 6 days. The fertilizing ability of sperm cells decreases to approximately 50% on the 10th day, and to approximately 15% on the 19th day. Occasionally, eggs may be fertilized up to 26 days after a single insemination.


FORMATION AND FERTILIZATION OF THE EGG
OVARY
AN EMPTY FOLLICLE FROM WHICH THE YOLK IS ENTERING THE OVIDUCT
ALBUMEN SECRETING PORTION OF THE OVIDUCT
YOLK
ALBUMEN SECRETED AROUND THE YOLK
ISTHMUS IN WHICH THE SHELL MEMBRANES ARE FORMED
THE UTERUS OR SHELL GLAND
SEMEN DEPOSITED INTO THE OVIDUCT
VENT
GERMINAL DISC (fertilized egg)

As an egg yolk is released from the ovary of the hen, it falls into the funnel of the oviduct where the female germ cell on the outer edge of the yoke is fertilized. The fertilized yolk then moves through the reproductive tract, acquiring the thick white, the shell membranes, the thin white, and the shell.

With the proper temperature and humidity after the egg is laid, the embryo continues to develop. The embryo is nourished by the egg contents which are completely consumed at the end of the 21 day incubation period.

8. REPRODUCTION FAILURES IN LIVESTOCK

Sterility, either permanent or temporary, may be caused for a number of reasons. A particular disease or specific physical defect can halt or hinder reproduction.

A. Anatomical Defects
   1. Cryptorchid - this condition is the failure of the testicles to descend into the scrotum. They are retained in the abdominal cavity resulting in complete sterility. Sometimes only one testicle is retained and the defect is called a monorchid condition. This does not cause complete sterility but results in a reduction of sperm. Both of these conditions are inherited and should be avoided in a breeding program.
   2. Scrotal hernia - this condition may not cause sterility but can cause an animal not to breed. If the hernia is large enough to allow part of an intestine to drop through it can be very dangerous.
   3. Malformed penis - due to an injury or birth defect the penis can be malformed to the extent that copulation cannot be performed.
   4. Freemartin - in the case of twin calves born of opposite sex, the female calf is, 90% of the time, sterile. The female reproductive tract does not completely develop in these animals.
   5. Infantile or absence of ovaries - sometimes during development, due to a hormone imbalance, the ovaries fail to develop enough or will not function. In some cases, they may even be absent.

B. Mechanical Injury
   1. Diseases or infections of the reproductive tract - a high percentage of reproductive failures in livestock are attributed to disease or infection. The most common diseases of the reproductive system are Brucellosis, Vibriosis, Trichomoniasis and Leptospirosis.
   2. Physical damage - these injuries usually occur due to improper handling, unsafe facilities, or fighting among animals.

C. Other Factors Affecting Reproduction
   1. Nutritional deficiences - certain amounts of vitamins and minerals are essential to efficient reproduction. The following vitamins and minerals are known to affect reproduction:
      (a) Vitamin A
      (b) Vitamin E
      (c) Phosphorus
      (d) Calcium
      (e) Cobalt
      (f) Iodine
      (g) Copper
      (h) Iron

      Lack of condition and too fat condition usually reduces reproductive efficiency.
   2. Endocrine disturbances - some female reproductive disturbances are hormonal or glandular in nature, such as irregular heat periods and abnormal function of corpus luteum and cystic follicles.
   3. Genetic factors - some bloodlines are known for having a high genetic factor or weakness for sterility or low productivity. Inbreeding may also result in lowered fertility.

GLOSSARY OF TERMS

1. Copulation - The physical procedure of natural mating between a male and female of the same species.
2. Egg cell (ovum) - The egg produced by the ovaries containing the female genes and chromosomes which join with those of the male sperm during fertilization.
3. Embryo - The fertilized egg is the embryo, which continues to grow through cell division until it becomes attached to the uterine wall to become the fetus.
4. Estrogen - The female hormone produced by the developing follicle on an ovary to regulate the heat period and cause male receptiveness by the female at the time of ovulation.
5. Fraternal twins - Two offspring produced during a single pregnancy each resulting from the fertilization of separate eggs.
6. Heat period (estrus) - The period of time when a female animal is receptive to the male.
7. Libido - Sex drive.

8. Maternal twins - Two offspring produced during a single pregnancy each resulting from the same egg and sperm causing two sexually and genetically identical individuals.
9. Parturition - The process of giving birth.
10. Placenta - The membrane which encompasses the fetus during pregnancy.
11. Progesterone - The hormone produced by the corpus luteum on an ovary during pregnancy which keeps estrus from occurring and causes the mammary system to develop.
12. Rudimentary copulatory organs - An underdeveloped sex organ such as is found in the rooster.
13. Siblings - Brothers or sisters.
14. Sperm cell (spermatozoa) - The male sex cell produced by the testes which carries the genes and chromosomes which combine with those of the ovum during reproduction.
15. Sterility - The inability to reproduce.
16. Urine - The liquid waste expelled from the body.
17. Viable - Capable of growing and developing.

SELECTED STUDENT ACTIVITIES

1. What hormone is produced by the testes and what is its function?

2. What is the vas deferens?

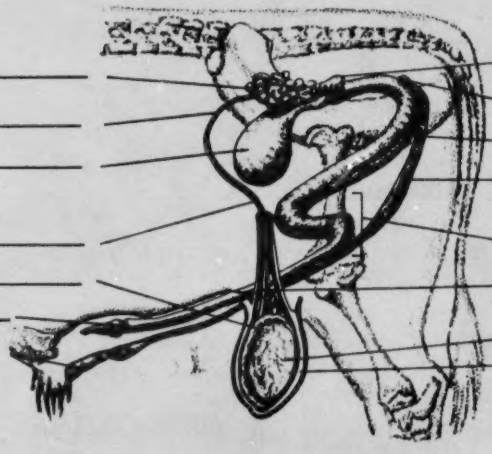
3. What is the purpose of the infundibulum?

4. What two hormones are produced by the ovaries?

5. How does the cervix function during pregnancy?

6. What is a freemartin?

7. Name the parts of the male reproductive tract that are identified in the following illustration:



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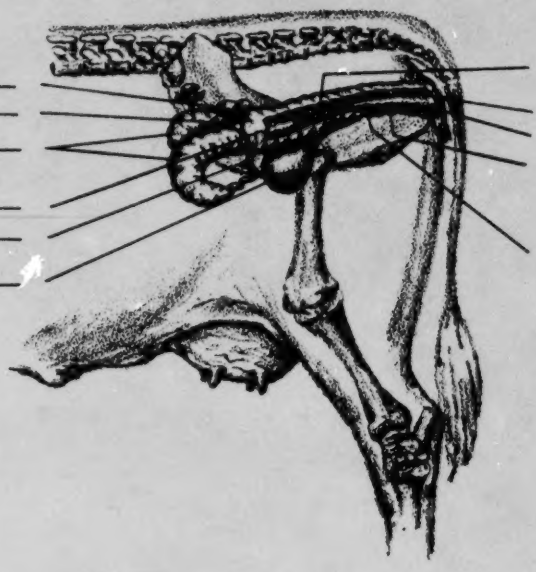
8. Name the parts of the female reproductive tract that are identified on the following illustration:



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BREEDING SYSTEMS

1. INTRODUCTION

Although most of the information contained in this topic refers to the breeding of cattle, it will also apply to the breeding of other species of livestock. One must also be aware that the terms used in describing the different methods of breeding are not universally accepted by all authorities.

There is not any one system or method of breeding livestock that will fit all producers. Different breeding systems offer advantages as well as disadvantages. The most important factor in the development of breeding animals is selection. Other factors which can greatly influence the genetic make-up in a herd are mutation and chance.

Actually, breeding systems may be classified into two groups: (1) Systems used by commercial producers, and (2) Systems used by purebred breeders. Different matings used by breeders in both groups are discussed in detail. In addition to the terms used to describe the different matings, * topcross, topincross, incross, and topcrossbred are other terms sometimes used to describe matings.

Several factors should be considered in determining the breeding system and matings to use:

1. Climatic conditions - Some breeds and crosses are more adaptable to certain weather conditions than others.
2. Markets - The location and type of market will influence the breeding system to use.
3. Knowledge of genetics - Some breeding systems are more complicated than others.
4. Size of operation - Crossbreeding, for example, requires several pastures.
5. Personal preference - This has a direct influence on the system selected. Some individuals prefer one system over another.
6. Available resources - Financing, equipment, labor, etc.
7. Goals of the breeder.

2. BREEDING SYSTEMS

An explanation of the systems used by the commercial breeder is given first, since the number of producers in this group far outnumber the purebred breeders. Grading up and crossbreeding are the two systems used by commercial producers.

Grading Up

This is the mating of purebred sires to commercial cows. Its purposes are to improve quality, develop uniformity, and increase performance in the offsprings or progeny. Noticeable improvement through the fourth generation can be expected when this system is used. After the fourth generation, the herd will carry 94 percent purebred or breeding of the sires. Progress is much slower in succeeding generations.

* All underlined terms are in the "Glossary of Terms."

Crossbreeding

In reality crossbreeding is the mating of two different purebreds; however, many commercial breeders refer to the progeny of grade animals showing a predominance of one breed mated to a purebred sire of another breed as crossbreds or Fls. This system might be referred to as indiscriminate crossbreeding. It may not give the results desired, as the progeny can be no better than the animals which produce them.

Two principal reasons for crossbreeding are to combine the desirable characteristics of two or more purebreeds to form a new breed or type which will have greater adaptability, and to produce hybrid vigor. New breeds have been developed by this method, but few producers are interested in developing a new breed.

Advantages of crossbreeding are as follows:

1. Weaknesses can be eliminated by breeding an animal strong in a character to animals that possess a weakness for the character;

2. The average productivity of the offspring is increased over either parent;

3. Crossbreds are more fertile;

4. Crossbreds wean heavier offsprings; and

5. Crossbreds are more vigorous.

Not fully understood by many, the importance of hybrid vigor in plants and animals has long been recognized. Heterosis, hybrid vigor, may be described as the extra growth or vigor found in crosses between unrelated groups or inbred lines. The word heterosis was coined from the genetic term, "heterozygous," which means different inheritance.

The half inherited from one parent is different from the half inherited from the other parent. Genes are responsible for the passage of the hereditary material from parent to offspring and are carried in the egg of the female and the sperm of the male. Genes are present in every cell of the body in pairs. Each parent contributes one member of each pair. Research has revealed that if each of the two genes of a pair are different they interact, or work together, and help each other. A large number of the gene pairs are unlike in a hybrid.

The degree of heterosis is determined by the genetic makeup of the breeds crossed. The wider the genetic background of the animals crossed, the greater the amount of heterosis. Likewise, the closer the relationship of the animals mated, the greater the depression of heterosis in the offsprings. However, the genetic ability of animals is not determined by the breed alone. It can be increased by crossing lines within a breed.

Heterosis levels vary from one trait to another. Those characteristics which are highly heritable and show a strong response to selection within a purebreed do not show a noticeable response in crossing. Low heritability traits respond poorly to purebreeding but have a high level of response to crossing. The livestock producer considering a crossbreeding program should be familiar with the heritability estimates of various traits.

The heritability estimates may vary among beef animals. A trait is highly heritable if it can be passed on to an offspring and is affected very little by environment. A trait affected greatly by environment has low heritability. For example, the color of a black sheep is not affected by the environment. This trait is highly heritable. Rate of gain is a trait affected by environment. Nutrition level, parasites, and other environmental factors can affect the rate of gain. Therefore, this trait has only a medium level of heritability.

Average Heritability Estimates for Traits in Beef Cattle

Average Percent	Trait	Level of Heritability
70	Carcass Rib-eye Area	High
60	Tenderness	
60	Final Feedlot Weight	
60	Eye Lid Pigmentation	
45	Feed Lot Gain	Medium
40	Efficiency of Gain	
40	Birth Weight	
40	Cow Maternal Ability	
35	Carcass Yield	
30	Weaning Weight	
30	Pasture Gain	
30	Carcass Grade	
30	Cancer Eye Susceptibility	
10	Calving Interval	Low

A Comparison of Several Traits in Purebred and Crossbred Cattle
Figure 1

	Breed or Cross of Dam and Sire				
	H X H	B X B	F1 X H	F1 X B	Secondcross X SG
% Pregnant	89.3	78.6	91.7	95.7	71.4
% Calved	82.1	71.4	86.4	91.3	71.4
% Weaned	78.6	42.9	70.8	86.9	71.4

Figure 2

Breed or Cross of Cow	Milk Yields, lbs.*	Percent Advantage Over H	B	H&B	Second Cross
Hereford	7.4				
Brahman	7.6				
Ave. of H&B	7.5				
Second Cross ($\frac{1}{2}$ A X $\frac{1}{4}$B $\frac{1}{4}$H)	12.8	73	68	71	
F1 ($\frac{1}{2}$B X $\frac{1}{2}$H)	13.4	81	76	79	5
Ave. for Crosses	13.1			75	

* Uncorrected for age

H - Hereford A - Angus B - Brahman SG - Santa Gertrudis

Figure 3

Mating Involved Sire X Dam	Percent Lost Conception to Birth *	Birth to Weaning **	Total
B X B	3.0	20.5	23.5
H X H	2.1	2.2	4.3
B X H	0.0	4.0	4.0
H X B	0.0	4.7	4.7
B X ($\frac{1}{2}$B X $\frac{1}{2}$H)	0.0	0.0	0.0
H X ($\frac{1}{2}$B X $\frac{1}{2}$H)	0.0	0.0	0.0
A X ($\frac{1}{2}$B X $\frac{1}{2}$H)	0.9	0.9	1.8
A X ($\frac{1}{2}$A X $\frac{1}{4}$B X $\frac{1}{4}$H)	0.0	0.0	0.0

* Calves lost as percent of cows pregnant H - Hereford A - Angus

** Calves lost as percent of cows that calved B - Brahman

In Figure 1, the offsprings from either the F1 cows bred to Herefords or Brahmans were superior to the purebreds and the Santa Gertrudis and second crosses. These were also superior in Figures 2 and 3 in the other comparisons.

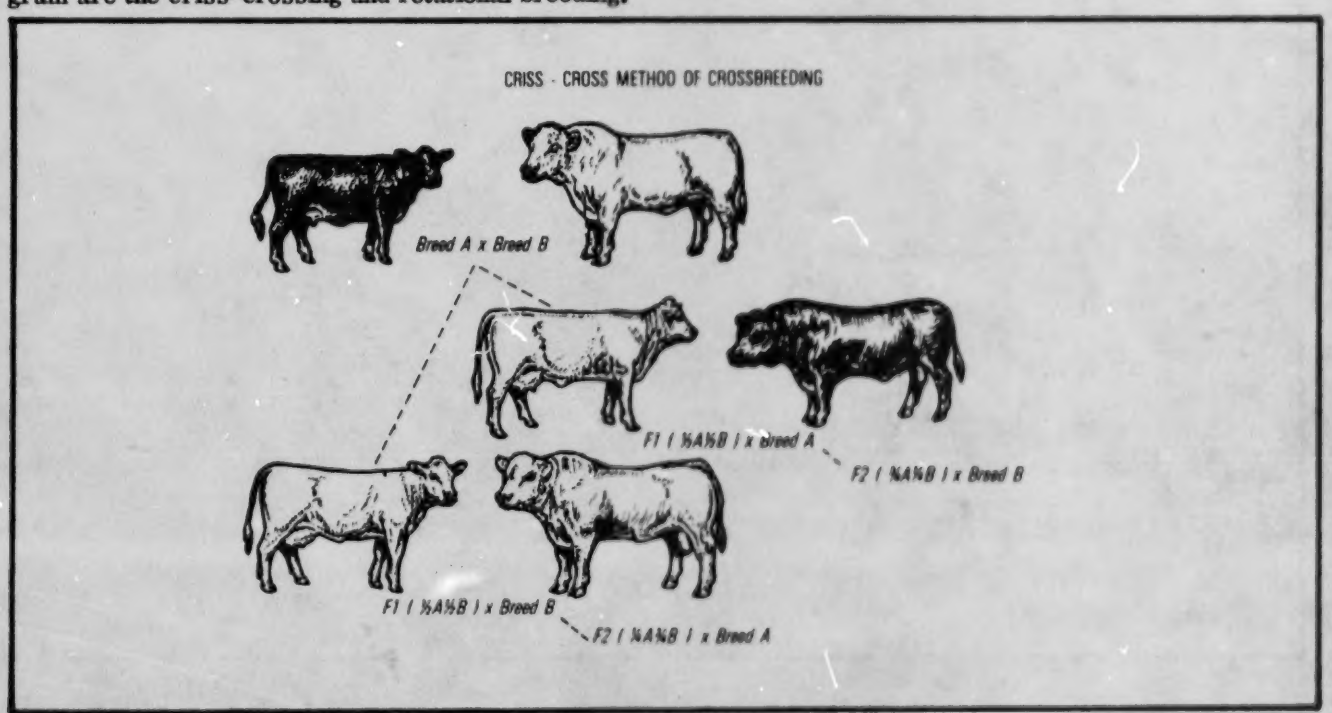
Feedlot Research of Purebreds and Crossbreds
Feedlot Gain - 140 - Day Test

Breeding of			Ave. Daily	Advantage for
Sire	Dam	Calves	Gains, lbs.	Crossbreeds
H	H	H	2.36 (2.20 Basepoint)	
B	B	B	2.04	
H	B	F1	2.43	10%
B	H	F1	2.44	10%
F1	F1	F2	2.1[illegible]	3% Loss

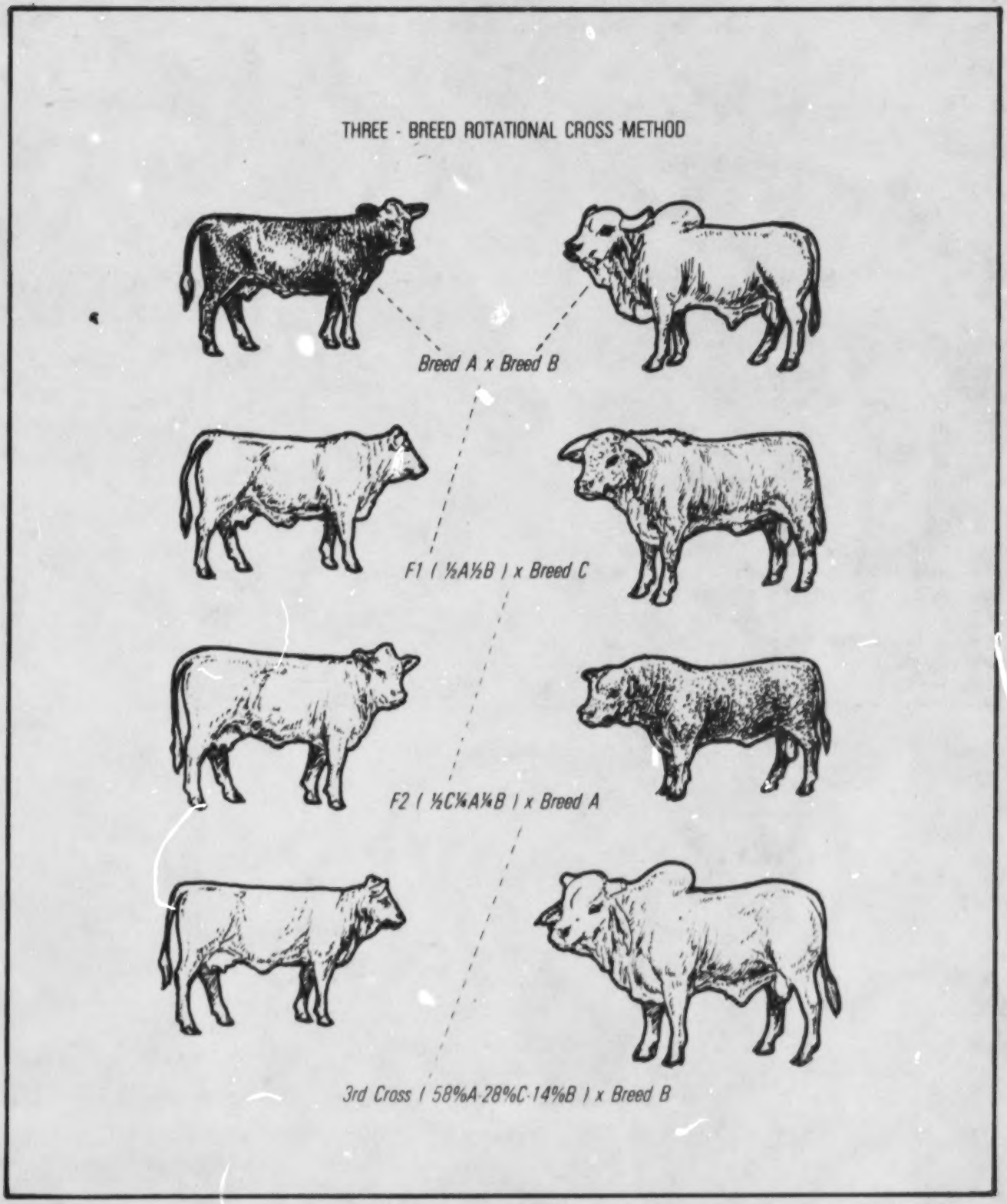
H - Hereford B - Brahman F1 - ($\frac{1}{2}$A X $\frac{1}{2}$B)

The F1 calves in the above illustration had a 10 percent greater gain than the average of the calves from the purebreds. F2 calves, produced by mating F1 to F1, decreased in hybrid vigor, as indicated by a decrease in average daily gains.

In order to maintain the many advantages of crossbreeding, the livestock producer must follow a systematic breeding program. Two methods of mating that may be used in maintaining a successful crossbreeding program are the criss-crossing and rotational breeding.



If the criss-cross method of crossbreeding is used, the breeder should divide his F1 females into two breeding herds. Bulls of breed A are mated to herd one, F1 females. Bulls of breed B are mated to herd two, F1 females. Each herd provides replacements for the other. Some hybrid vigor is lost using this method.



The best system is the three - breed rotational plan because maximum vigor is maintained. This system can be used very successfully by breeders who maintain three or more herds. However, the breeds used to develop the F1s should be distinctly different.

Three - Breed Rotational Plan Using Three Breeds

Herd	Sire	Dams	Offsprings
1	Breed A	Breed A 14% B 29% C 57%	Replacement heifers - Go to herd 2
2	Breed B	Breed B 14% C 29% A 57%	Replacement heifers - Go to herd 3
3	Breed C	Breed C 14% A 29% B 57%	Replacement heifers - Go to herd 1

Only the advantages of crossbreeding have been given up until this point. Crossbreeding is not a substitute for good management, and not every livestock producer should crossbreed. A producer who does not have a problem in any of the areas of production (growth rate, fertility, mothering ability, mortality, and general vigor) has no reason for crossbreeding. Some disadvantages of crossbreeding are as follows:

1. Crossbred cattle are discounted on some markets; however, this prejudice is being overcome;
2. Several pastures are needed;
3. Replacement heifers with about the same breeding are needed; and
4. Selecting is more difficult.

Systems used by purebred breeders are discussed below.

Purebred Breeding

This is the mating of animals of the same breed which are registered by a breed association, or are eligible for registry. A breed association is a group of breeders who have organized for the purpose of recording the lineage of their animals, keeping the breed pure, and promoting the breed or their animals. A purebred animal's lineage can be traced to the original foundation animals of the breed which were first accepted for registry. In a few instances, breed associations have allowed the breeding of certain animals or breeds of animals outside of the registry to be bred to registered animals. The purpose is to infuse a characteristic (s) or trait (s) into the registered animals.

One should not become confused by the word purebred. This does not necessarily guarantee that an animal is superior in any way. However, purebred animals are usually superior in many respects to grade animals.

All producers cannot be breeders of purebred livestock. The purebred breeder should have adequate capital and a knowledge of breeding, or be able to hire someone with the knowledge. Few purebred breeders receive a great return on their investment. However, there will always be a need for purebred animals for crossbreeding and grading up of commercial animals.

Inbreeding

This is a practice of breeding animals that have closely related ancestors on both sides and within the first four or five generations.

The purposes for inbreeding are to concentrate the inheritance and to fix desirable traits in a group of animals. Starting with a good group of animals, the breeder can make further improvements by inbreeding. Many outstanding herds have been developed by this system. Other ways in which inbreeding can be used to improve livestock are (1) to form families, (2) to produce seed stock, (3) to develop lines for crossing, and (4) to determine the genetic value of an individual.

Disadvantages of inbreeding are decreased reproduction, vigor, survival rate, and growth rate.

Different matings that may be used to inbreed and the amount of inbreeding from such matings are shown in the illustration below. Production efficiency of animals with 6.25 percent or less of inbreeding is usually not affected.

Amount of Inbreeding from Various Matings

Mating	Offspring
Brother X Sister Parent X Offspring	25% inbred
Half Brother X Sister Uncle X Niece Nephew X Aunt	12.5% inbred
Half Uncle X Niece Nephew X Half Aunt	6.25% inbred
Cousin X Cousin	3.125% inbred

Linebreeding

This is a less intense form of inbreeding which is used to maintain and further improve animals through the selection of high quality animals. The breeder using this system should recognize the potentials and limitations. This system does not offer the possibilities of improvement nor regression that inbreeding does. Breeders practicing linebreeding usually mate animals that are both related to an outstanding animal, but animals are never mated that are closer than half brothers to half sisters. Some methods of linebreeding are as follows:

Selected bull X half sisters
Son of above bull X daughter of above dams
Grandsire X granddaughters

Some very popular bloodlines have been developed through linebreeding. Linebreeding is often used when an outstanding individual is not available for matings. If the individual is available, he should be mated to as many nonrelated animals as possible, so as to spread his characteristics. Linebreeding is only successful in herds that have a high degree of excellence and outstanding individuals as indicated by progeny tests. A breeder commencing to linebreed should select good individuals and mate them to the best of recent ancestors.

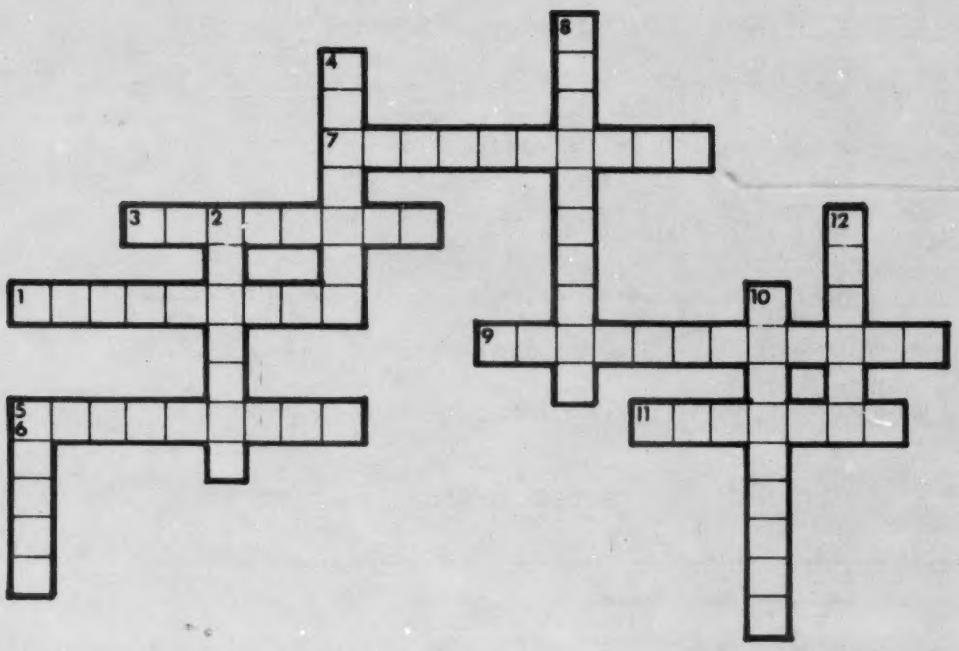
GLOSSARY OF TERMS

1. Grade Animal - An animal having non-purebred ancestors.
2. Heterosis - Hybrid vigor.
3. Incross - The progeny from the mating of individuals of inbred lines (usually purebreds) of the same breed.
4. Progeny - Offsprings of animals.
5. Topcrossbred - The progeny from the mating of inbred sires with noninbred dams of a different breed.
6. Topcross - Breeding two different families of the same breed.
7. Topincross - The progeny from the mating of an inbred sire with a noninbred dam of the same breed.

SELECTED STUDENT ACTIVITIES

1. The wider the genetic background of the animals used for crossbreeding, the greater the amount of _____.
2. Low heritability traits have a high response in _____.
3. Linebreeding is a form of _____.
4. Maximum vigor is maintained in crossbreds by using the _____ - _____ _____ _____.
5. Two groups of breeding systems are 1. _____ and 2. _____.
6. List 2 reasons for crossbreeding.
7. List 3 reasons for grading up a commercial herd of cattle.
8. List 4 ways in which inbreeding may be used to improve livestock.

9. Crossword Puzzle



Across:

1. Hybrid vigor
3. Breeding two different families of the same breed.
5. A system of mating commercial cows to a purebred sire.
7. A method of crossbreeding.
9. A less intensive form of inbreeding.
11. A term used when referring to the ancestors of an animal.

Down:

2. The offspring from a mating.
4. The progeny from the mating of inbred lines of the same breed.
6. An animal that has non-purebred ancestors.
8. The practice of mating closely related animals.
10. The most important factor in the development of breeding animals.
12. A term used to describe the breeding of two animals.

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METHODS OF BREEDING AND BREEDING LIVESTOCK

1. SELECTING A BREEDING SEASON

An integral part of the returns from the producer's investment is affected by the selection of the breeding season and the related calving season. Offsprings of about the same weight and age are easier to handle and usually command a better price. For these reasons, all of the offsprings from a livestock enterprise should be born within a 40-to-60 day period.

The choice of breeding season will depend upon the desired season for the birth of the offsprings. Producers usually prefer either spring or fall for the birth of offsprings. Each has advantages and disadvantages.

Advantages of Spring Births:

1. Less housing is required;
2. More economical to feed dry animals during the winter;
3. Green pasture can be provided for dams during the greatest demand period;
4. Labor costs are reduced because of green grazing; and
5. Offsprings can be sold or put on feed in fall.

Advantages of Fall Births:

1. Offsprings are weaned at a time when feeder prices are more favorable;
2. Less heat and insects; and
3. Labor supply is greater.

A number of factors must be considered in selecting a breeding season. The importance of some of the factors listed below will vary from one specie of livestock to another.

1. Climatic conditions - A particularly important consideration since they affect the amount of equipment and housing needed.
2. Available labor - This may determine the system of mating to use, as well as the time of year the offsprings are born.
3. Time animals are to be marketed - Prices are usually better during certain periods of the year.
4. Equipment and housing available - In certain areas of the state, some species of livestock will have to be placed in a barn and provided heat during the winter months.
5. Availability of grazing - If the females and offsprings are to be provided grazing, it is more dependable and easier to provide in the spring.
6. Livestock show dates - Classes for purebred breeding animals at livestock shows are based on ages. Animals having the maximum age for a class have an advantage.
7. Purpose for which livestock is produced - The birth of herd replacements determines the season in which they may be bred and the length of time it takes to bring them into production.

2. AGE OF PUBERTY AND BREEDING AGES OF LIVESTOCK

Season of birth, temperature, nutrition (growth), and heredity affect the age at which animals reach * puberty. It should be emphasized that age of puberty and breeding age are two distinct areas. Just

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* All underlined terms are in the Glossary of Terms.

because an animal has reached puberty does not mean that it is capable of reproducing. Usually it is advisable to allow animals to develop and mature after reaching puberty.

Recent research reveals that weight (body development) is more important than age in determining when animals will reach puberty. The chart below gives the normal age at which some farm animals reach puberty.

AGE OF PUBERTY FOR FARM ANIMALS

Species	Puberty Age (Months)
Sheep	5-8
Swine	5-8
Horses	12-18
Cattle	8-14
Goats	4-8
Poultry	$5\frac{1}{2}$-$6\frac{1}{2}$

Breeding ages will vary according to the development of the animals within a breed and among the breeds within a specie. The livestock producer must determine the minimum breeding age of the particular specie to be bred. It is often advantageous to breed at a rather early age in order to reduce production expenses and for other reasons. However, sometimes it is to the producer's advantage to delay breeding. Suggested breeding ages for some species of livestock are listed in the following chart.

BREEDING AGES FOR LIVESTOCK

	Average Age (Months)	
Species	Females	Males
Cattle	15-24	18-24
Swine	8-10	8-9
Sheep	14-20	12-20
Goats	12-18	12-20
Horses	24-36	24-48

Heifers - The proper breeding age for heifers may vary widely depending upon body growth and development. Generally, they should be bred at 15 to 20 months of age and weigh between 575 and 750 pounds, depending upon the breed. The following chart is based on recent research conducted at Texas A&M University.

Weights Beef Heifers Reach Puberty		
Breed	Weight, lbs.	Percent Reaching Puberty
Brahman Cross (F1)	675	50
	725	70
	750	90
Angus	575	50
	625	70
	675	90
Hereford	600	50
	650	70
	700	90

Although the weights for the Brahman and Santa Gertrudis are not shown, both age and weight are factors in their reaching puberty.

Breeding heifers to calve as two-year olds offers a physiological advantage as well as increasing milk production in the heifer. Also, early breeding will increase the lifetime production of the animal from 1 to 1.3 calves; that is, if the heifer is rebred in her second breeding season. Supplemental feeding of heifers or providing them with good pastures will cause them to develop faster and breed earlier.

Gilts - Gilts must have a well-developed body in order to withstand lactation stresses. Their bodies are usually developed enough for breeding at 8 to 10 months of age. They should weigh approximately 225 pounds.

Ewes - Ewes should be bred the first season after they are one year old so they will lamb as 2-year olds. Some ewes can be bred to lamb as early as 12 to 14 months, but this practice is not recommended.

Does (Goats) - The same recommendation for ewes applies to does. Spanish does may be bred earlier, however, than Angora does.

Mares - The best practice is to breed mares to foal at four years of age. However, they can be bred in many instances much younger.

Breeding Ages for Males

Breeding ages of males is not as important as for females. The principal consideration is the number and quality of offsprings that the male can sire in a given season. Total number of services allowed will vary according to age, development, health, temperament, condition, breeding system used (hand or pasture mating), and distribution of services.

If pasture mating is practiced, several other important factors such as range carrying capacity, size of area, and herd size will influence the number of females serviced by one male. While the exact number of females that can be served by a male cannot accurately be predicted, general practices followed by the better producers do not vary significantly. The mature bull can serve 25 - 50 cows using the pasture mating system and 40 - 50 cows if hand mating is used. One bull to about 25 cows is the standard ratio for range conditions. There is a difference between breeds, but bulls should be ready for service at 18 - 24 months of age. Smaller breeds usually are ready for service at an earlier age than larger breeds. The males of the smaller beef breeds mature earlier because testosterone

production in males causes the growth of the long bones of the body. Since the long bones in the smaller breeds are shorter, they mature earlier.

The ram may be placed into the breeding program at 12-20 months of age. Usually, the ram can breed 50-75 ewes under hand mating conditions and 30-60 ewes under pasture mating conditions. A ratio of one ram to 25 or 30 ewes is recommended for range conditions.

Boars may begin breeding at 8-9 months of age. At this time they should be capable of breeding 25-50 sows under hand mating practices, and 35-40 sows in a pasture mating program. Mature boars (one year and older) are capable of breeding considerably more sows than are young boars.

Stallions vary a great deal in their breeding capacity with regards to age. Two-year-old stallions may breed 10-15 mares; three-year olds 30-40 mares; four-year olds 40-60 mares; mature stallions 80-100 mares; and over 18 years old 20-40 mares. Stallions should not be allowed to pasture mate because of the possibility of injury.

REPRODUCTIVE CYCLES OF LIVESTOCK

Reproductive cycles of the females of the various species of livestock consist of (1) duration of the heat period (estrus), (2) duration of the heat interval, (3) time of ovulation in relation to heat, and (4) gestation period for pregnant females.

REPRODUCTIVE CYCLES OF LIVESTOCK

Species	Duration of Heat		Duration of Heat Interval (Days)		Time of Ovulation in Relation to heat	Average Gestation Period (Days)
	Range	Ave.	Range	Ave.		
Cow	8-30 hrs.	14 hrs.	18-24	21	14 hrs. after end	281
Sow	1-5 days	2-3 days	18-24	21	Near end	114
Ewe	1-3 days	35 hrs.	14-20	16	At end	150
Goat	2-3 days	2½ days	15-24	21	Near end	151
Mare	2-11 days	6 days	16-30	22	1 to 2 days before end	336

Gestation tables which indicate the approximate date of birth in relation to the date of breeding are available and will save the producer time in determining dates offsprings will be born.

BREEDING DEFECTS

Lethal characters are hereditary and are transmitted from the parents to the offsprings. A lethal gene may cause physical abnormalities or death at or near birth, or the animal to be unprofitable. Animals inheriting these characters should be disposed of and not kept in the breeding herd. The defects listed below appear in different degrees of severity.

1. Crooked legs or neck
2. Cancer eye in cattle (partially inherited)
3. Twisted nose
4. Missing dew claw
5. Tailless
6. Dwarfism
7. Brain hernia

8. Genital abnormalities
   a. Scrotal hernia
   b. Vaginal and uterine prolapse
   c. Malformed penis
   d. Incomplete descent of testes
9. Single toe or "mule foot"
10. Extra legs
11. Lineback in Hereford cattle
12. Horns, buttons, or scurs in polled cattle
13. Skin and hair color
14. Stiff-legged horses
15. Inverted nipples in swine
16. Hair swirls on swine
17. Undershot or overshot jaws in sheep

5. PREPARING ANIMALS FOR BREEDING

To insure a high conception rate, males and females of most species of livestock must be prepared for breeding. Percent of females giving birth and weaning weight greatly affect the success of a livestock enterprise. In fact, the fastest means of increasing profits is to increase the number of females giving birth. This has a tremendous effect on the cost per pound of the animals produced.

Cost of maintaining a breeding female of any specie of livestock varies from ranch to ranch. However, the producer should be able to determine this cost. After this cost is determined, the cost per pound of offspring can be calculated. The following illustration shows the importance of a high calving rate in cattle and the different costs based on weaning weight and percent of calf crop. A similar comparison could be made for other species of livestock.

PRODUCTION COST PER POUND

(Beef - $ 137.50 per cow maintenance cost)

Percent Calf Crop					
100	550	500	450	400	350
	25.9	28.5	31.6	35.7	40.6
90	495	450	405	360	315
	28.7	32.6	34.2	39.6	45.3
80	440	400	360	320	280
	32.1	35.7	39.6	44.5	50.8
70	385	350	315	280	245
	37.1	40.7	45.3	50.9	58.2

Using a 90 percent calf crop and an average weaning weight of 495 pounds as an example, the producer's cost per pound of calf is 28.7 cents. A 70 percent calf crop and 350-pound calves increase the production cost to 40.7 cents per pound.

The age animals are weaned in a herd may vary as much as 2 to 3 months in many livestock operations. Weaning weight is influenced by two major factors: (1) age at weaning, and (2) growth rate. Older animals usually weigh more at weaning time. Weaning weight, in reality, then is influenced by when the offsprings were born, or how soon the females were bred during the breeding season. A delay in breeding reduces the weight of the offspring and average weaning weight and increases the cost per

pound of production. The conclusion might be drawn that reproductive performance of the females in a herd has the greatest influence on many of the factors affecting profits, losses, and success of a livestock enterprise.

Factors affecting reproductive performance are as follows:

1. Percent of breeding females coming into a fertile heat;
2. Number of breeding females conceiving at each heat period; and
3. Death losses.

From the very limited information provided above, one can understand the importance of preparing animals for breeding.

Cattle

To increase the average weaning weight, the cows must be bred early in the breeding season. The cows must calve 45 days before the beginning of the breeding season in order for 90 percent of them to breed early. Cows breeding early in the season will have a relatively short calving period, and the calves will have some uniformity in age.

For the cows in a herd to calve on schedule they must breed within 82 days after they calve. This allows the normal gestation period of 283 days and keeps them calving within a 12-month period.

Elements influencing when a cow comes into heat are (1) age, (2) post-calving rest, (3) genetic capability, (4) nutrition, (5) semen fertility and breeding efficiency, and (6) disease. Only the above elements which pertain to preparing for breeding are discussed, even though the producer should be concerned with all of them.

Age of the cow influences the number of days after calving before she comes into heat. Older cows come into heat quicker than young cows. First-calf heifers tend to have a lower pregnancy rate and require special preparation in order to get them to cycle. They take longer to come into heat after calving. Several conditions are responsible for the delayed heat. One is first-calf heifers have to perform all the body functions of a mature cow, while at the same time attempting to grow. The problem is further compounded by the fact that the heifer is shedding incision teeth, which limits her capacity for grazing. Milk production also affects the breeding performance of first calf heifers.

Research has proven that a 90 percent conception rate in first-calf heifers can be maintained if they are properly handled after their first calf. Since lactation is one of the conditions influencing the rebreeding of heifers, limited suckling of the calf will help in maintaining a high conception rate. After the calves are 30 days old, they should be penned separately from the heifers and allowed to nurse only once daily. About 30 minutes are required for the calf to empty the heifer's udder of milk. Calves handled in this manner should be creep fed to keep them growing. Creep feeding the calves also reduces lactation stress in the heifers.

An alternative to the above method is the early weaning of calves. The calves are weaned at three months of age. A disadvantage of this method is that a large number of the heifers will not breed until after the calves are weaned. These heifers will not breed within the 82 days required to keep them on schedule, and will not produce the second calf within a 12-month period. Calves weaned at this age will require supplemental feeding and extra labor to handle them. Some breeders breed the heifers 20 to 30 days earlier than the rest of the herd in order that they can be rebred during the regular breeding season.

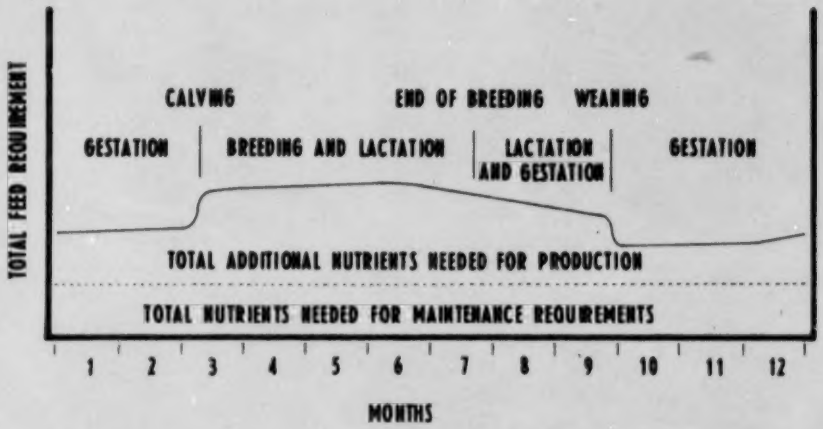
Post-calving rest influences the conception rate and the number of reproductive problems occurring during gestation and the following breeding season. Cows should not be bred until about 45 days after calving. About one-third of the cows with a shorter post-calving rest experience serious reproductive problems. However, a few cows in a herd will conceive shortly after calving and will have no problems.

Retained placenta is the most common problem of early breeding. The cows conceive, give birth to a calf, but fail to properly release the placenta. If attention is not given to a cow with this problem, the uterus will become infected. This will reduce conception rate, and these cows will calve 2 to 5 months late.

Genetic capability and nutrition are two other factors influencing breeding performance. Selection based on regularity of breeding is an effective means of increasing overall breeding efficiency. This should be considered in both total herd selection and the selection of heifers. Genetic capability may be determined by examining the females for pregnancy about 45 days or more after the bulls are removed, or when calves are weaned. Nonpregnant females are removed from the breed and sold.

Nutrition is the most important of all environmental factors affecting reproduction. Most breeding failures and late calving can be related to a lack of adequate nutrition. Nutritional requirements for cows fluctuate considerably throughout the year.

FEED REQUIREMENT FOR A COW RAISING A CALF
(12 - Month Period)



To nourish the unborn calf and get the cow off to a good start at calving, extra feed is needed during the gestation period. After calving the feed requirements are further increased. Milk production is the cause of the increased needs. If extra feed or grazing is not provided, the cow will mobilize body fats to compensate for the deficiency and will suffer a weight loss. Too much of a weight loss will prevent the cow from cycling and 13 to 15 months may lapse before calving.

A system of scoring cows on body condition has been developed by Texas A&M beef cattle specialists. The score indicates the nutritional level received by the cow. Also revealed is the amount of weight a thin cow needs to gain before calving in order to rebreed quickly. Overly fat cows can lose weight and still rebreed. It should be emphasized that the score is strictly on body condition and does not reflect the merit of the cow.

BODY CONDITION SCORES

Condition Score 90-100 Days Before Calving		Description of Body Condition	Feeding Recommendations
	1	Poor - Starving; bordering on inhumane; Survival questionable during stress. No palpable fat covering a long backbone or ribs.	Needs to gain more than 350 lbs. Economics questionable.
Too Thin	2	Very Thin - Poor milk production; chances for rebreeding are slim to none. Some fat present along backbone, but no fat cover over ribs.	Needs to gain 300 - 350 lbs. Economics questionable.
	3	Thin - Lowered milk production; poor reproduction. Fat along backbone and slight amount of fat cover over rib.	Needs to gain 200 - 300 lbs.
Borderline	4	Borderline - Reproduction bordering on inadequate. Some fat cover over ribs.	Needs to gain 150 - 200 lbs.
	5	Moderate - Minimum necessary for efficient rebreeding. Good milk production; generally good overall appearance. Fat cover over ribs feels spongy.	Needs to gain weight of fetus (100 lbs.)
Optimum	6	Moderate to Good - Milk production and rebreeding acceptable. Spongy fat cover over ribs and fat beginning to be noticeable around tailhead.	Needs to gain weight of fetus (100 lbs.)
	7	Good - Fleshy, maximum condition needed for efficient reproduction. Spongy fat cover over ribs and fat around tailhead.	No weight gain needed.
Too Fat	8	Fat - Very fleshy, unnecessary; no advantage in rebreeding from having cows in this condition. Cow has large fat deposit over ribs, around tailhead, and below vulva.	Can probably lose 50 - 150 lbs.
	9	Extremely Fat - Wasty and patchy; may have calving problems. Cow extremely over conditioned.	Can probably lose 100 - 200 lbs.

SCORES FOR EVALUATING BODY CONDITION

The scores are based on a 1,000-lb. cow. Gain or loss recommendations for smaller cows can be adjusted. For example, a cow with a condition score of 3 which needs to weigh 800 pounds at calving should gain 160 to 240 pounds to reach a body score of 5.

It is recommended that the cows be separated by condition score 90 to 100 days before the start of calving season. Each group is fed according to their condition.

Since much of the information on preparing cattle for breeding applies to other livestock species, the discussion of other species will be much briefer.

It has often been said that "a bull is one-half of the cow herd." This is only partially correct, but a bull is far more important than any single cow in a herd, since he breeds 20 - 30 cows per season. Physical fitness and semen quality are both very important in the preparation of a bull for breeding. Such factors as general health, condition of feet and legs, age, teeth, and abnormalities of reproductive organs should be checked. Tender feet or lameness will prevent the bull from traveling to find cows in heat. The bull should be checked for reproductive abnormalities, such as adhesions of the penis, which prevents intromission with the female.

Another important consideration is the bull's "libido" or sex drive. This can be observed when the bull is placed with cows that are in heat. Some breeds, particularly Brahman or breeds with Brahman breeding, show a lack of interest in cows when humans are present. In such instances, it will be necessary for the observer to remain out of sight.

Annual semen checks are a "must." Also important is the fact that a bull may become ineffective during the breeding season due to injury. It is not uncommon for bulls that have been subjected to handling and hauling stresses to temporarily cease sperm production. These bulls should be fertility tested after an adjustment period.

Sheep

Four to eight weeks before breeding ewes they should be flushed with good, lush pasture or extra concentrates. Flushing increases conception rates and influences twinning.

Heavy locks of wool, manure, and other foreign matter should be clipped from around the docks of ewes before the start of the breeding season. Also, while this area is being sheared, the ewes (breeds having wool on their faces) should be sheared around the eyes. This is referred to as tagging because the wool having foreign materials imbedded in it is known as tags. Tags may prevent the ram from breeding the ewes and increases the possibilities of ewes having wool worms. Wool worms are attracted to dock area because of the high moisture level in the wool after lambing.

Shearing the rams before the breeding season will make them more active and aggressive, particularly in warm weather. If it is impractical to completely shear show or sales rams before the breeding season, the wool from their bellies (penis region) and neck should be sheared. If the hooves of the ram are long, they also should be trimmed before turning the ram with the ewes.

In order to identify the bred ewes and the time of breeding, it is desirable to use a marking harness which is strapped to the ram's chest. Time of breeding may be reliably estimated by changing colors of the chalk in the marking harness periodically.

An acceptable alternative to the harness is the use of a thick paste smeared on the brisket area of the ram. This paste must be replenished at least every other day in order in insure clear marking of the ewe's rump. Tar or paint should never be used because it tends to stain and ruin the wool.

The color of the paste or crayon should be changed every estrus cycle (16 days) in order to find ewes that are coming back in heat and require re-breeding. Also, this is an ideal method of checking for non-breeding females and sterile males.

Thick lubricating oil and paint tinting colors make good paste. Yellow ochre, venetian red, and lamp black make good tints to give the paste different colors. A common practice is to start with light colors and use progressively darker colors as the breeding season continues. If a large number of ewes fail to breed, the ram should be fertility tested, or replaced with another ram. Temporary sterility may be brought about by lack of exercise or improper conditioning.

Swine

Sows should be flushed two to three weeks before breeding. This practice insures more profitable litters by: (1) causing more eggs to be released, and hence, larger litters, (2) the sows are more certain to conceive when bred, and (3) they tend to come into estrus more readily. Sows of normal weight should have their daily feed intake increased so that they gain about 1 to 1½ pounds daily. Plenty of lush pasture and exercise should be made available for overweight sows, while the concentrate ratio is decreased. As always, provide plenty of clean water and minerals.

Boars should have free access to a well-fenced pasture of about ¼ acre to provide exercise needed for sperm production. Overfat boars and very thin boars are usually poor breeders. They must be kept in a thrifty and vigorous condition in order to be virile, potent breeders.

Horses

Most authorities agree that mares are the most difficult of all livestock species to settle and to conceive. Plenty of exercise and adequate feed should be provided. Before breeding, mares should be checked for any signs of venereal disease, sickness, and other unsoundness. Also, be certain that the

mare is in standing heat before attempting to breed her.

If possible, the mare should be taken to the stallion for service. The foal should be taken along if the mare is to be gone over five or six hours. If necessary, milk the mare by hand. Allow the mare to become quiet and settled before service. Overheated or excited mares should be cooled before breeding. Always be certain the mare is in heat and is ready for service. The mare may be teased by tieing a stallion on the opposite side of a breeding partition. After teasing, clean the stallion's penis and sheath area with castile soap and warm water, and rinse with clean water. Cotton is preferable to a sponge for cleaning.

The mare's tail should be wrapped with a clean, inexpensive cloth or gauze in order to keep the stallion's penis clean, and to keep tail hair from interfering with breeding. Only the upper six to eight inches of the tail needs to be wrapped. Next, wash the external portion of the mare's reproduction system, similar to that of the stallion.

For greater control of the mare, hobbles and a twitch are used. The twitch may be removed while the mare is breeding. Allow the stallion to mount the mare only when he is ready for service. After mating, return the stallion to his stall or pen. Allow the mare to remain quiet for a short time after service. Any undue exertion or excitement of the mare should be avoided. After the mare is bred, she should receive the same ration as before breeding. If the mare does not conceive she will come back in heat in approximately 21 days and may be re-bred.

The stallion should have access to a roomy box stall which opens into a pasture paddock of about 2-3 acres in size. The stallion should be separated from the mares by a double horse-proof fence. Provide plenty of water and feed to meet the stallion's needs. He should be exercised each day.

6. SYSTEMS OF MATING

Hand Mating

Purebred breeders use this system to control the matings. When the female comes into heat, she is brought to the male for service. This requires additional labor, as the female must be checked twice daily during the breeding season. Additional labor is also required in bringing the females to the male. Advantages of this system are a male can service more females, controlled matings, and accurate records (breeding dates, etc.) are easier to keep.

Pasture Mating

This system allows the males to be with the females throughout the breeding season or throughout the year if desired. If uniformity in size and time of parturition are of importance, males must be limited to a breeding season rather than yearly. Nearly all commercial herds use this method. Records for registered herds are more difficult to keep when more than one male is used for pasture mating. Where exact records are desired, use the recommended number of females per male, and keep them in separate pastures. This system may be used for all species of livestock.

Corral Mating

This system is utilized mostly by horse breeders, and entails putting the mare and stallion together in a well-fenced corral. Both mare and stallion are returned to their pens after service.

Stud Mating

Some poultry breeders use this system. A male and the females are penned together and allowed to breed.

Flock Mating

A system where an optimum number of females are penned with several males and used by poultry breeders.

Pen Mating

This is also used primarily by poultry breeders. One male is penned with 8 to 20 hens for breeding.

Artificial Insemination

The use of A. I. is increasing and is used extensively by dairy farmers and producers of turkey hatching eggs. It consists of depositing semen in the female reproductive tract by artificial means.

MATING GUIDE

	Age of Sire	Hand Mating No. of Females	Pasture Mating No. of Females
Bull	1-2 yrs.	10-12	8-10 (one bull for
	2-3 yrs.	25-30	20-25 25 cows under
	3 yrs. or older	40-50	25-40 range conditions)
Boar	8-12 months	24	12
	1 yr. or older	50	35-40
Stallion	2-3 yrs.	10-15	Not recommended
	3-4 yrs.	20-40	for most operations
	4-5 yrs.	30-60	
	5-18 yrs.	80-100	
Ram	Lamb	20-25	Not recommended
	1 yr. or older	50-75	35-60
Poultry		Flock Mating	
Light breeds (Leghorn, etc.)		15-20	Males over 3 yrs.
General purpose breeds (Wyandotte, etc.)		10-15	of age are not good
Heavy breeds (Dark Cornish, etc.)		8-12	breeders.

7. SELECTING A BULL FOR BREEDING HEIFERS

Heifers experience more difficulty in calving than older females. Many of the calving problems in heifers can be eliminated by proper selection of bulls for the matings. This does not mean the selection of any particular beef breed, nor is it necessarily related to the size or age of the bull. A bull produces the same size calves at puberty as he produces at full maturity. The general belief that a small, young bull produces smaller calves is not based on facts. Also, the visual appraisal of a bull's physical characteristics is of little value in the selection process.

The selection of a bull for mating to heifers should be based on several factors, but the major factor to consider in attempting to prevent calving difficulty is the birth weight of the bull's progeny. Since calves are sold by weight, another important consideration in the selection of a bull to breed to virgin heifers is the growth rate of the progeny.

Breeders conducting progeny tests can provide the information needed for sire selection. Progeny tests normally include percent easy births and calving ease. Both of these are related to birth weight. Percent easy births is the percentage of a bull's calves born without assistance and is expressed as a ratio. For example, a ratio of 100.4 means that the sire had a .4 higher percentage of easy births

than other bulls of the same breed used in the comparison. Calving ease is a subjective rating of the relative ranking of a bull within his breed for the ease with which his calves are born. This is also expressed as a ratio.

Growth rate may be determined by observing the 205-day adjusted weight (weaning weight) of the progeny. This is the weight taken at weaning and adjusted within sex for age of calf and age of dam to a standard 205-day, mature cow basis. The greater the 205-day adjusted weight, the better the growth rate.

PROGENY DATA

Data	No. of Progeny	Progeny Average	Ratio
Length Gestation	85	280	-----
Birth Weight	66	76.9	104.9
% Easy Births	119	----	100.4
205-day Adj. Wt.	82	471	104.5

The data in the above illustration are hypothetical and provided to familiarize the student with the progeny data discussed above. Attention is directed to the number of progeny from which the data could have been collected. The number of progeny for each item of data may vary. The above includes only a part of data that may be available from a progeny test. Other data sometimes available are average daily gain in the feedlot, carcass quality, and yearling weight.

GLOSSARY OF TERMS

1. Conception Rate - The rate or percentage of animals becoming pregnant.
2. Estrus Cycle - The interval between heat periods.
3. Fertility Tested - A test to determine if a male animal is fertile.
4. Flushed - Giving an animal extra feed and care prior to breeding.
5. Lethal Characters - Gene that causes abnormalities or death in animals.
6. Marking Harness - A harness strapped to a ram that marks a ewe's rump with crayon when she is bred by the ram.
7. Ovulation - A discharge of eggs from the ovary.
8. Parturition - Giving birth to young.
9. Placenta - The vascular organ in mammals that unites the fetus to the uterus.
10. Puberty - The age at which an animal reaches sexual maturity.
11. Standing Heat - A period during the estrus (heat period) in which the female will stand and accept the male.
12. Testosterone - A hormone located in the testes of bulls.
13. Twinning - Giving birth to twin lambs.

SELECTED STUDENT ACTIVITIES

1. List 4 stages in the reproductive cycles of animals.
   a.
   b.
   c.
   d.

2. What determines the number of services of a male?
   a. e.
   b. f.
   c. g.
   d.

3. List the two factors that affect the weaning weight of animals.
   a.
   b.

4. The success of a livestock enterprise is greatly affected by (a) _____ and (b) _____.

5. The fastest way to increase the profits of a livestock enterprise is to increase the _____ _____.

6. _____ of a cow influences the number of days after calving before coming into heat.

7. The two advantages of breeding heifers to calve at 24 months of age are (a) _____ _____ and (b) _____.

8. The best means of determining genetic capability is to _____ _____ the cows 40 to 60 days after the breeding season.

9. In order for cows to calve on schedule, they must breed within _____ days after calving.

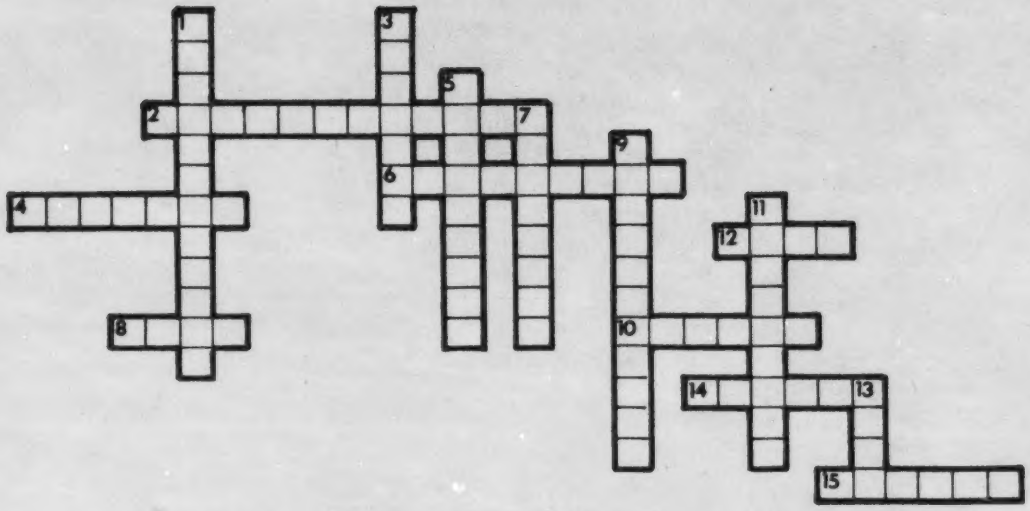
10. To prevent a high incident of calving problems, cows should be given a minimum of _____ days of post-calving rest.

11. The purpose of scoring cows on body condition is to determine the (a) _____ _____ and (b) _____.

12. The economics of feeding a cow to gain _____ to _____ pounds is questionable.

13. The nutritive requirements for a breeding female is the greatest during the _____ and _____ period.

14. Crossword Puzzle



DOWN:

1. A hormone that is produced in the testes of male beef animals and causes long bone growth and faster development in the males of small beef breeds.

3. The offspring.

5. Period of pregnancy.

7. Term used when ewes give birth to twins.

9. The 45-day rest period after calving (two words).

11. The period in which animals are giving milk.

13. Term used for wool matted with foreign matter.

15. Another term used for heat period.

ACROSS:

2. The time during estrus when a female will stand and accept the male (two words).

4. A term used when animals reach sexual maturity.

6. The most important environmental factor affecting reproduction.

8. A system of mating where the female is brought to the male. Used by purebred breeders to control breeding.

10. Characters that cause abnormalities or death.

12. An animal specie having the most difficulty conceiving.

14. A factor more important than age in determining when heifers will breed.

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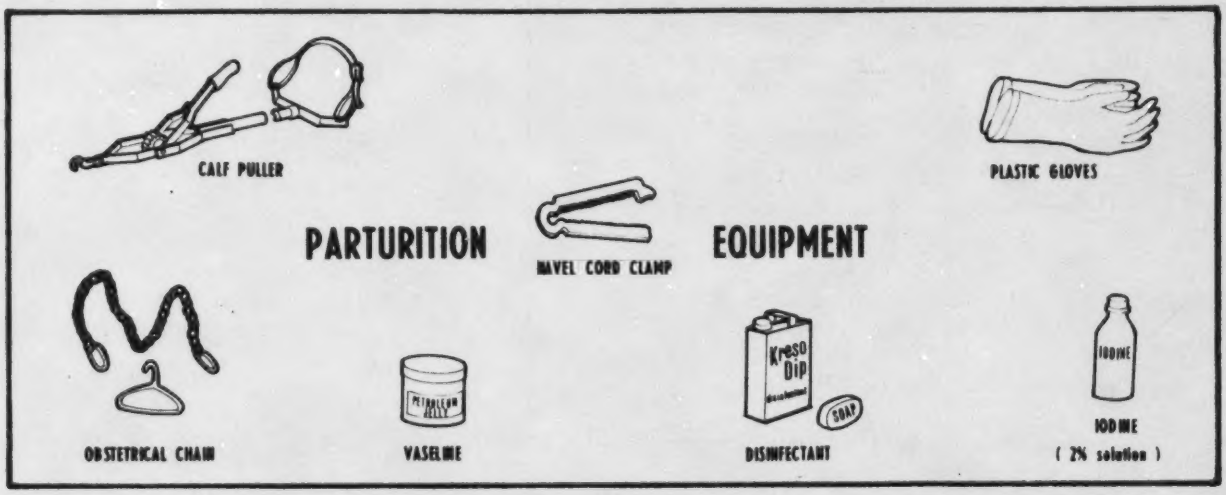
CARE OF LIVESTOCK AT PARTURITION

1. INTRODUCTION

A critical stage in the production cycle of livestock is just prior to and during *parturition. By keeping accurate breeding records, the producer will be aware of the approximate time of parturition and can be prepared to render assistance to the animal if it is needed. An individual breeding record, or a record of when the male(s) was placed with and taken from the herd, may be kept.

Some species of animals require more assistance at parturition than others, and producers who plan to give assistance to animals should make preparations before parturition begins. Assistance given at the proper time will save many young animals, as well as some of the females having parturition problems.

In preparation for the parturition season, the producer should have on hand several items:



2. SIGNS OF PARTURITION

It is difficult to determine the exact date or time of parturition, but there are certain signs of approaching parturition with which the livestock producer should become familiar. Some of the signs are more distinct in some animals and species than others. Signs that can be observed as animals approach parturition are discussed and illustrated below.

Illustrations of Some Signs

Distended Udder

A distended udder is noticeable in cows and mares two to six weeks before parturition. The udders of sheep do not usually become distended until ten days to two weeks before parturition.

All underlined terms are in the Glossary of Terms.

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Muscle Shrinkage

Muscles around the pin bones and tail head shrink and fall away in cattle and sheep as parturition time approaches. Muscle parts at the top of the buttocks shrink and fall away about seven to ten days before a mare foals.

Vulva

The vulva in all livestock swell and become enlarged just prior (two to three days) to an animal's giving birth.

Wax on Teat Ends

Wax forms on the ends of the teats of ewes and mares two to four days before parturition.

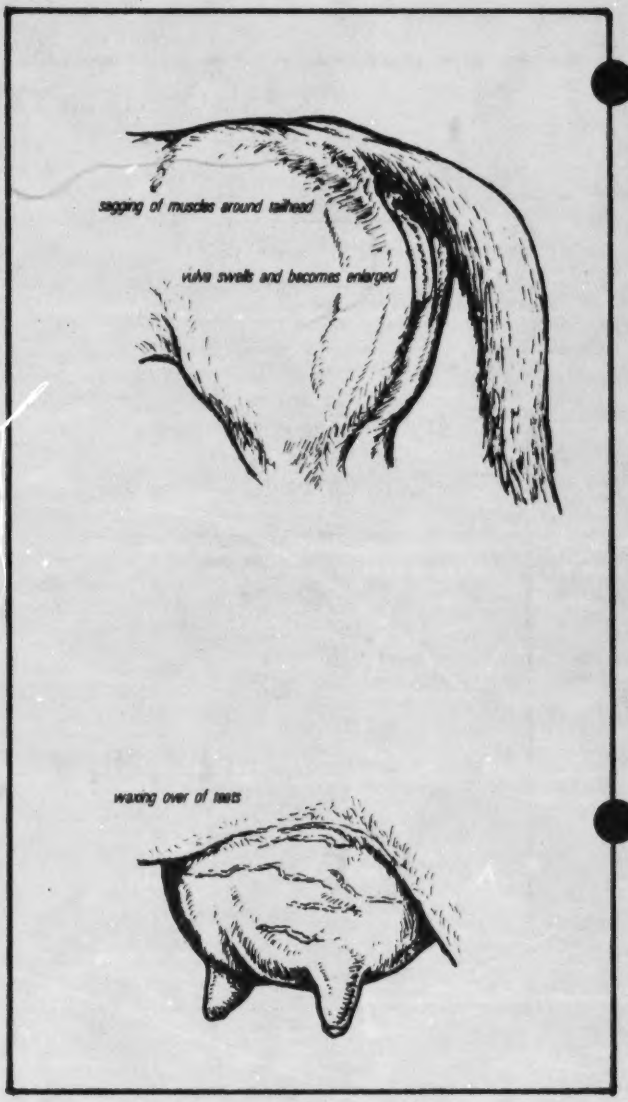
Restlessness and Nervousness

All female species of livestock become restless and nervous just prior to parturition. The female usually will isolate herself from the rest of the herd.

Although swine are not mentioned in some of the signs listed above, most of them also apply. Most swine producers keep accurate records in order that they can place the females in a farrowing facility a few days before they farrow.

Change in Udder Content

The contents of the udder in all livestock will change from a watery fluid to a heavy colostrum milk two to three days before the offspring is born. Sows normally farrow within 24 hours after milk develops in their nipples.



3. PREPARING LIVESTOCK FOR PARTURITION

The best place for most species to give birth is a clean, dry pasture; but this is not always possible or practical. If prepared quarters are going to be used, the pregnant animals should be moved to these quarters several days in advance of giving birth. This allows them to become accustomed to the quarters.

Cattle

Since few calving problems are experienced by older cattle, they are normally calved on a pasture or paddock. An attendant rides through the pasture two to three times a day so that assistance can be given to cows having calving problems. During inclement weather, it may be necessary to provide stalls for calving. The stalls should be clean, well-ventilated, and comfortable.

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Swine

Before moving the gilts or sows into the farrowing house, it should be thoroughly cleaned and disinfected. The heating equipment is checked to see that it is operating properly. The ideal temperature is between 60 and 70 degrees Fahrenheit. Farrowing stalls should be bedded with a light covering of ground corn cob, peanut hulls, wood shavings, chopped hay, or shredded fodder.

Prior to moving the sow into the farrowing house, she should be washed thoroughly on her sides and underline. This will remove worm eggs and parasites which could infect the pigs. A disinfectant soap and warm water are used.

Sows are placed in farrowing stalls four to five days before farrowing. They are given a laxative feed and taken out of the stalls for daily exercise.

Mares

A dry, clean pasture or paddock is an ideal place for mares to foal. If weather conditions do not permit foaling in a pasture, a roomy box stall away from other animals should be provided. A solution composed of eight ounces of lye in 20 gallons of water may be used to disinfect the stall. A mixture of four ounces of lye to 20 gallons of water is recommended for disinfecting feeders and troughs. Obstructions which might cause injury to the mare or foal should be removed.

A few days before the mare foals a light laxative feed is substituted for one-third to one-half of the grain ration. Wheat bran is sometimes used for the grain substitute.

Ewes

Ewes should be tagged four to six weeks before lambing. In the tagging operation, wool and foreign matter are removed from the face and eyes, teats, udder, rectum, and insides of hind legs. Some advantages of tagging are as follows:

1. Prevents the young lamb from nursing a tag and starving;
2. Keeps area around rectum and vulva free of dung and afterbirth;
3. Makes the lamb easier for the ewe to find;
4. Makes it easier for the ewe to eat; and
5. Reduces the chances of the ewe getting wool worms.

Several methods are used by producers in preparing ewes for parturition:

1. Pasture Lambing - Several variations of pasture lambing are used. One method is to allow the ewes to lamb without assistance or special care. Another method is to work the ewes through a cutting gate every two weeks and group the ewes that are going to lamb in a few days. These ewes are grazed in a small lambing pasture, either permanent or temporary. The producer goes through the pasture several times a day to check the ewes. A ewe having lambing difficulty is given assistance. After the lambs are five to seven days of age, the ewes and lambs are moved to a pasture with other ewes receiving the same kind of care.

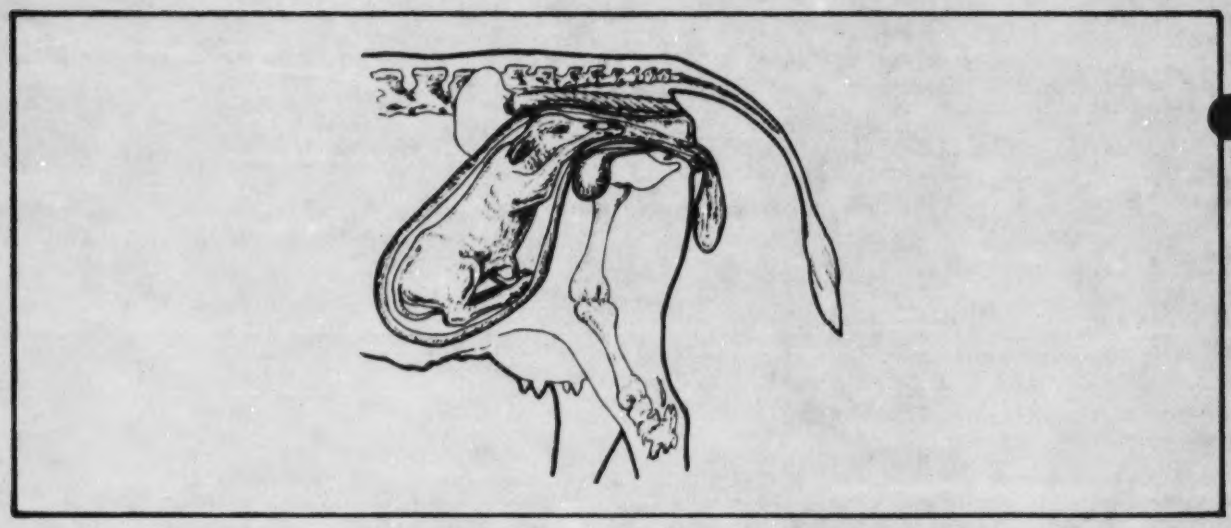
2. Combination Pasture and Shed - During the day ewes are allowed to graze in a pasture and are penned under a shed at night. Ewes lambing either place are separated from the flock.

3. Lambing Pens - Ewes are lambed in individual pens or several ewes are placed in a pen and moved to an individual pen as they lamb.

4. CARING FOR THE COW AT CALVING TIME

First calf heifers should be watched closely and assistance in calving provided if needed. Normally, older cows do not experience calving difficulty.

Normal Presentation of Calf



The attendant should stay out of sight if the presentation of the calf appears normal. From one to two hours are usually required for the birth of a calf in a normal presentation.

Although the above illustration shows a normal presentation in a cow, it also applies to mares and ewes.

It is often difficult to determine exactly when to render assistance. In a normal presentation, mild infrequent labor pains start a few hours before actual parturition. After some time, a water bag appears outside the vulva. It increases in size until it ruptures from its own weight. A second water bag (amniotic bladder) follows the first one and appears with the fetus. After the second water bag ruptures, labor pains (straining) become more intense. Presentation normally occurs soon after the rupture of the second water bag. Normally the front feet come first and are followed by the nose (resting on feet), shoulders, middle, hips, and hind legs and feet.

If presentation is not shortly after the rupture of the second water bag, assistance should be given. The steps in giving assistance are as follows:

1. Check fetus to determine if it is in a normal position;
2. Turn fetus in proper position, if possible;
3. Place obstetrical chains around each leg just above pasterns. After the chains are looped around each leg, make a half-hitch in each chain and place it on each leg just below the loop. This will prevent the chain from slipping and injuring the feet. Cotton rope may be used instead of the chains, but it should be disposed of after one use. This will prevent the spread of disease. The rope cannot be sterilized; and
4. Pull fetus outward and downward as the female strains. The proper procedure is to pull one leg then the other leg. If additional pressure or force is needed in order to move the fetus, the chains are attached to a calf puller.

Shown below are illustrations of some abnormal presentations. Under each presentation is a suggestion for correcting the presentation prior to exerting pressure or pulling on the fetus.

Buttock presentation with fetus corded - turn calf to normal position trying not to sever cord

Back presentation - turn calf to normal position

Head upward and backward - push calf back and straighten head

Both forelegs bent at knees - push calf back and straighten legs

Hind feet in pelvis - push calf back and bend hind legs at hocks

One foreleg bent at knee - push calf back and straighten leg

After assisting with the birth of the calf, the attendant should wipe the mucus from the calf's nostrils. It may be necessary to apply artificial respiration to get the young animal to start breathing. To prevent infection, a navel cord clamp is placed on the navel cord. Also, the cord is painted with a two percent iodine solution to eliminate the possibility of infection.

The afterbirth should be disposed of; otherwise, the cow will eat it. Eating of the afterbirth by the cow is an instinct developed in the wild state to prevent the odor from attracting wild animals which might harm the calf.

Under normal conditions, the afterbirth is expelled three to six hours after presentation. If the afterbirth is not expelled in 24 hours after presentation, it should be removed. If it is not properly removed, the cow may become a nonbreeder. A plastic glove is placed on the hand and arm, and the glove is lubricated with vaseline or linseed oil before inserting the hand and arm into the vagina to remove the afterbirth. An antiseptic should be placed in the uterus and the cow given an antibiotic after the removal of the afterbirth.

5. CARING FOR THE SOW AT FARROWING TIME

According to estimates, 30 to 35 percent of all baby pigs are lost at birth. The number of pigs saved at birth can make the difference between profit and loss.

Most sows do not need assistance at birth; however, an attendant should be available to dry the pigs and place them under a heat lamp. The number of additional pigs saved will pay for the attendant's time.

The following care should be given the young pigs after birth:

1. Wipe membrane from pigs with a clean, dry cloth;
2. Clip the navel cords about 2½ inches from the bodies of the pigs;
3. Swab navel cords with a two percent iodine solution;
4. Provide heat for pigs (90 to 95 degrees Fahrenheit at floor level);
5. Inject pigs with iron (Preferred site for injection is under forearm or in neck. Give a second injection in 14 days.);
6. Clip needle teeth (At birth, pigs have eight needle teeth, two uppers and two lowers on each side of the mouth. Cutting these teeth will prevent the pigs from cutting each other and the udder of the sow. Side-cutting pliers are used to cut the teeth just above the gum level.);
7. Provide plenty of fresh water for sow;
8. Ear notch pigs (Purebred breeders and some commercial producers ear notch the pigs with the sow's number in one ear and the pig number in the other ear.);
9. Equalize litter sizes by combining litters (Small weak pigs are placed with heavy milking sow, while larger pigs are placed with sow giving less milk.);
10. Cut the pigs' tails one-half inch from body if pigs are going to be raised in confinement.
11. Provide pigs with pig prestarter on fourth day (Small amount of fresh starter should be made available daily.);
12. Feed 20 percent starter ration until pigs weigh 10 pounds; and
13. Castrate pigs at two weeks of age.

6. CARE OF THE MARE AT FOALING TIME

Older mares in the proper condition and which have previously foaled seldom have problems in the presentation. However, an attendant should be close by but not in sight. The presence of an attendant may prevent injury to mare and foal. Some mares will postpone parturition as long as possible if the attendant is in sight.

Indications that the mare is going to foal are uneasiness, nervousness, lying down and getting up, biting of the sides and flanks, sweating in the flanks, switching of tail, and frequent urination. With a normal presentation the mare will foal in 15 to 30 minutes after the above signs are noticed. At the height of the labor pains, the mare will usually lie down. It is in this position that the foal is usually born. A reasonable length of time should be given the mare to foal. If she does not in this time, assistance should be given immediately. The attendant should follow good sanitation practices and be as quiet and gentle as possible. The procedure for giving assistance is the same as was explained for the cow. A delay in parturition may cause death of the fetus, which is often caused by a twisted umbilical cord.

Afterbirth should be expelled by the mare in one to six hours after parturition. The attendant may wish to tie the afterbirth to the mare tail to prevent the mare and foal from stepping on it and picking up bacteria which could infect the uterus. If the afterbirth is retained longer than six hours, a veterinarian should be called. Mares retaining the afterbirth for a long period of time can get laminitis, a disease causing lameness.

After the mare has foaled, a restricted amount of water should be made available to her periodically. The feed should be light (bran and oats) and restricted for the first week.

If the mare had the foal in conditions other than a clean pasture, the navel cord of the foal should be treated with a 10 percent iodine solution. This will prevent joint-ill or navel-ill, a fatal disease in 50 percent of the cases. To apply the iodine, a wide mouth bottle is filled with the solution, the navel cord is placed in the bottle, and the bottle is pressed against the foal's abdomen. If it is necessary to cut the foal's navel cord, it should be cut diagonally across the cord or severed by scraping with a sharp knife. This will prevent excessive bleeding.

The foal should be on its feet and attempting to nurse the mare within two hours after it is born. If it is weak and unable to nurse, the attendant should assist it by holding it up to the mare. It may be necessary to milk the mare and feed a very weak foal with a bottle. The foal should receive the colostrum milk produced by the mare.

Since constipation can be fatal to a foal, the attendant should check to see that it has a bowel movement within 12 hours after it is born. An enema of warm water containing a small amount of glycerin should be given to a sluggish foal. If diarrhea develops in the foal, it is caused by either unsanitary conditions or the mare's milk. If caused by milk, the feed given the mare should be decreased. Bacterial diarrhea is treated with an antibiotic.

7. CARE OF THE EWE AT LAMBING TIME

Well-fed, healthy ewes seldom have trouble lambing. The lambing system used will determine whether the ewe can be given assistance while lambing. Ewes lambed in a small pasture, pens, or under a shed should be observed periodically but not bothered unless assistance is needed. Should assistance be given to the ewe, the same procedure as used for a cow should be followed.

After the lamb is born, it is dried and the mucus removed from its nostrils. It may be necessary to give the lamb artificial respiration to start it breathing. This is accomplished by blowing into its mouth or by rubbing the hands across its ribs. Other young animals can be given artificial respiration in the same manner. Heat should be provided for the young lambs in cold weather.

The attendant should check the ewe to make sure the lamb nurses, the ewe cleans herself of afterbirth, and the ewe is not constipated. Water and a light feed should be provided for the ewe. For several days after the birth of the lamb, both ewe and lamb should be observed for possible problems.

GLOSSARY OF TERMS

1. Colostrum Milk - Milk that is secreted by the female a few days after giving birth. It has a high protein and immune body content.

2. Parturition - The giving of birth by the female.

3. Presentation - The position of the fetus, and the giving of birth.

SELECTED STUDENT ACTIVITIES

1. Two ways in which artificial respiration may be given to a very young animal are by _____ _____ and _____.

2. Diarrhea in a foal is caused by _____ conditions, or the _____ _____.

3. If a foal does not have a bowel movement within _____ hours after birth, it should be given an _____.

4. The navel cord of a foal born in a stall should be treated with an _____ _____.

5. Indications that a mare is going to foal are _____, _____, and _____.

6. Baby pigs should be fed a _____ on the _____ day of age.

7. Iron injections for pigs are given in the _____ or _____ _____.

8. A pig has _____ needle teeth at birth.

9. Explain how you would give assistance to a cow when the fetus is in an anterior presentation with its head upward and backward.

10. What is the most serious anterior presentation?

11. Give a disinfectant solution that may be used in stalls.

12. Why is the sow washed thoroughly before being moved to the farrowing house?

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PREGNANCY DIAGNOSIS (Palpation)

PREGNANCY DIAGNOSIS (PALPATION)

1. INTRODUCTION TO PALPATION

Today's inflation and continued high prices make it extremely important for today's cow-calf operations to be as efficient as possible. The producer must consider the cost for maintaining each cow for a year on the basis of his particular operation. The cost for maintenance on all cows then must be charged against his calf crop for that year. It is easy to see that any cows that did not produce a calf for that year reduced the profits considerably.

In order to survive in a cow-calf operation today it is extremely necessary that the producer have a high percentage calf crop each year. A technique called palpation* has been developed to help the producer determine which of his cows are not bred. He then can cull these cows from his herd and rid himself of unnecessary costs that rob his profits.

Although the technique of palpation is relatively simple, the use of records will greatly increase the layman's accuracy and speed up the process. If a person knows when a cow was with a bull; he then has some idea as to the stage of pregnancy she should be in if she is bred.

2. EQUIPMENT NECESSARY FOR PALPATION

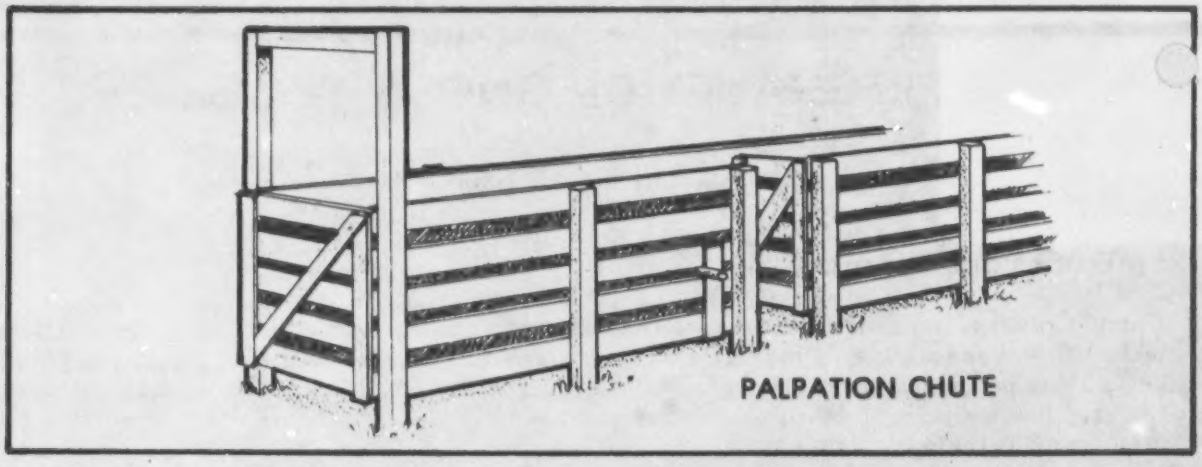
a. Protective Covering for the Arm and Hand - Since the palpator must insert his hand and arm into the rectum of the cow, it is necessary that he cover them. Plastic or rubber sleeves may be used for this purpose. If rubber sleeves are used, they should be dried after use and covered with talcum powder before being stored. No special care need be taken with plastic sleeves as they are disposed of after use.

b. Lubricant - The lubricant should be applied to the covered hand and arm to facilitate entry into the cow's rectum. Liquid soap is one of the best lubricants, because it provides a slick covering over the arm and does not irritate the cow's rectal cavity as detergents sometimes do.

c. Chute - The holding chute should be constructed so that the animal can stand on the ground in a normal position. There should be a gate in front of the cow and a pipe or pole for insertion through the chute behind the animal approximately 4 inches above the hocks. The pipe keeps the palpator from being kicked and also prevents the animal from backing up. An entrance gate through the

*Underlined terms are in the Glossary of Terms.

side of the chute should also be provided. It should open to the inside of the chute so that animals behind the cow being palpated can be closed off when the palpator steps into the chute to begin his work.



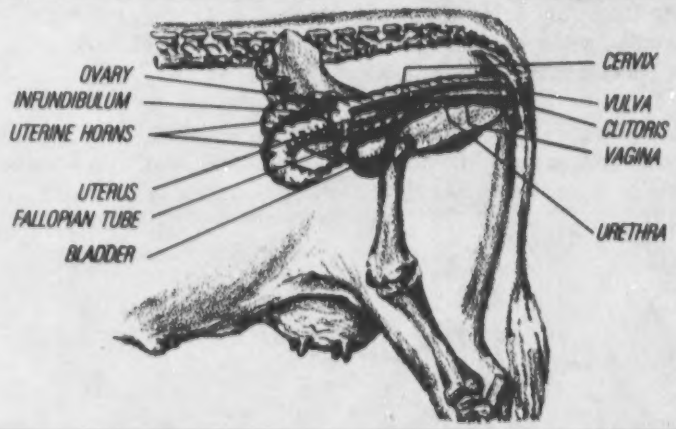
The animal's head should not be placed in a stanchion or headgate as this will tend to excite the cow. The floor of the chute should be dirt; but when concrete or wood flooring is used, some type of cleats or cross-slats should be constructed to prevent the cow from slipping.

3. THE REPRODUCTIVE SYSTEM AND PALPATION

Determining pregnancy in cattle by palpation is not particularly difficult, but it requires experience, practice, and a thorough knowledge of the cow's reproductive system.

To accurately determine pregnancy, the palpator must insert his hand into the cow's rectum, locate the reproductive tract through the rectal wall, and determine whether a condition of pregnancy exists. Since operation is performed completely by sense of touch, the palpator must know where all the reproductive organs are located and how they feel at different stages of pregnancy.

FEMALE REPRODUCTIVE SYSTEM



a. Vulva - This is the external portion of the female reproductive tract and may be seen as two prominent lips. Although this organ is of no importance in palpation, it can be used as an indicator in the latter stages of pregnancy. During this period the vulva will become swollen and more prominent.

b. Vagina - The vagina is located just inside the vulva and serves as a depository for sperm during a natural service by a bull. The rear portion of the vagina serves as a common passageway for urine and the passage of young at birth. The vagina is usually the first organ felt during palpation because it is directly under the rectum. It is felt as a soft, spongy cylinder.

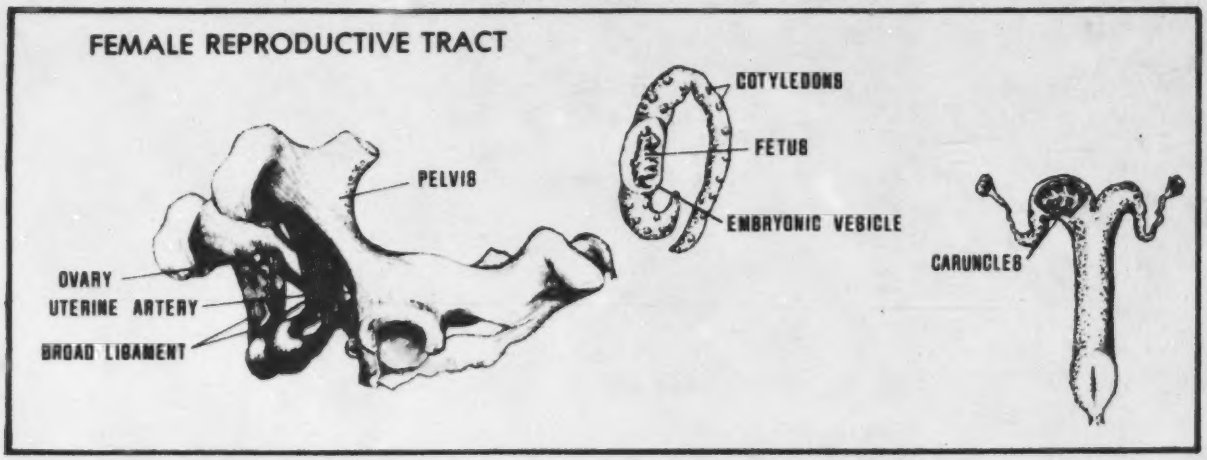
c. Cervix - This organ is located at the upper end of the vagina. It is an important "landmark" in

palpation, and it is usually easy to locate because of its hard, gristly feel.

d. Uterus - This organ lies directly in front of the cervix. The cow's uterus is composed of two uterine horns that are connected. The fertilized egg implants itself in the wall of one of the horns, and the ovum begins to develop. The palpator can follow the two horns by beginning at the upper end of the cervix and following them to their respective ends. The horns are larger at the lower end and taper off in size toward the upper ends. The location and feel of the uterus will depend upon the stage of pregnancy and the age of the cow.

e. Fallopian Tubes - These small tubes are located at the upper ends of the uterine horns. They act as the passageway for the egg as it moves into one of the uterine horns.

f. Ovaries - The female egg develops in a follicle on the ovary. The ovaries are suspended in the body cavity by ligaments attached to the top of the abdominal cavity. They are located approximately at the ends of the fallopian tubes on each side of the body cavity. In a normal cow they are about 1/2 inch wide, 3/4 inch deep, and 1 inch long and should feel firm.



g. Pelvis - The pelvis forms a bone cradle for the open reproductive system. As pregnancy advances, the cervix and uterus move down over the pelvic ridge and into the body cavity. Because the pelvis never moves, it is an excellent "landmark" in palpation. It can be felt by pressing down through the rectal wall immediately after the palpator pushes his hand into the cow.

h. Embryonic Vesicles - After the fertilized ovum has moved into the uterine horn and begun to develop, it is surrounded by a fluid-filled sac. This sac causes an enlarged area in the horn.

i. Caruncles - The caruncles are raised prominences that line the walls of the uterus. They serve as connecting points for the fetal membranes. After connection at about 38 days, they serve as nutrient and waste exchange between the fetus and its dam.

j. Cotyledons - These are the "buttons" on the fetal membranes that attach themselves to the caruncles that line the uterus.

k. Broad Ligament - This is the support for the uterus.

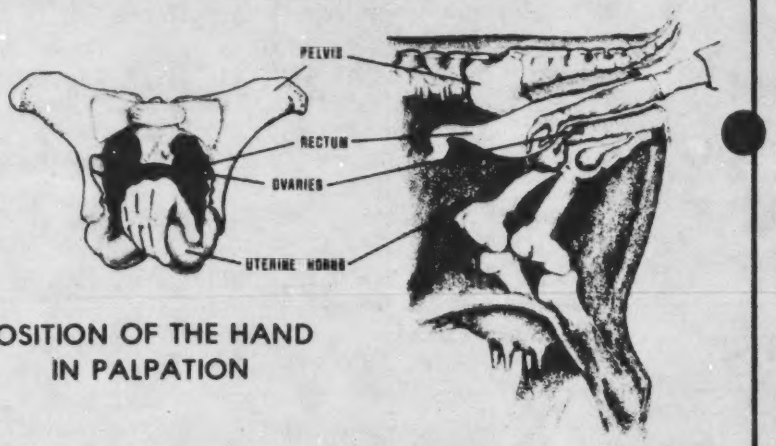
l. Uterine Artery - This artery is the main blood supply from the dam to the developing fetus.

4. PALPATION

Palpation may be done with either hand. One hand can be used to grasp the cow's tail as leverage. The covered, lubricated hand should be shaped into a wedge by bringing the fingers close together. This will help in the initial thrust into the rectum. As the hand goes through the cow's anus, the hand should be formed into a fist to push aside fecal material and straighten the folds of the rectum.

INSERTING HAND INTO RECTUM

PUSHING FECAL MATTER ASIDE



POSITION OF THE HAND IN PALPATION

Beginning palpators may wish to clean the fecal matter from the cow's rectum, especially if the animals have been on dry range. Cleaning the rectum will increase the sense of feel when the palpator is inexperienced.

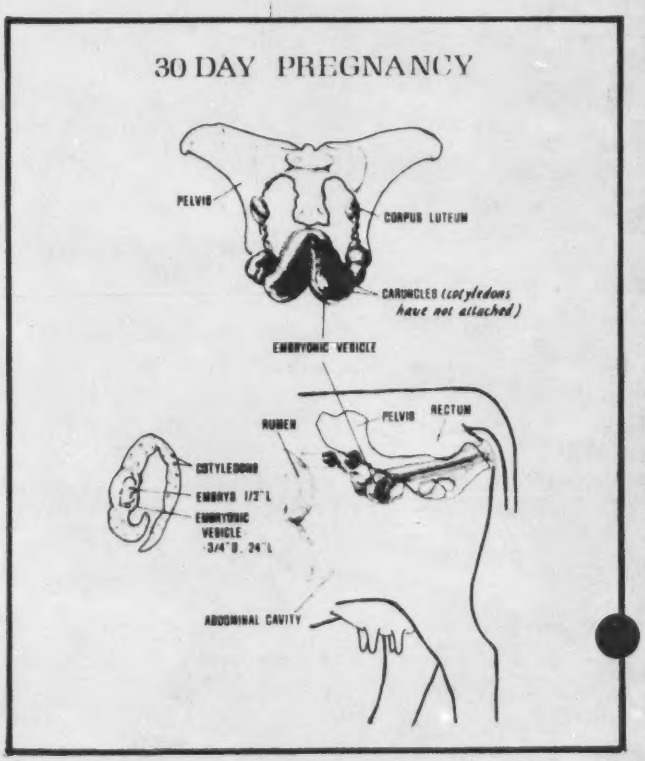
Feeling through the rectal wall is much like feeling through a layer of thin rubber. The thickness will vary slightly with individual cows and may vary greatly between breeds. The heavier breeds, such as Santa Gertrudis and Charolais, usually have thicker rectal walls than do smaller breeds. The larger body cavity of the heavier breeds may also present difficulties in locating the reproductive tract after the palpator's hand has passed the pelvic ridge.

The palpator should locate a point of identification immediately after entering the rectum. Finding the pelvic ridge is a good place to start. If the animal is not pregnant the reproductive tract will normally lie just to the rear of the ridge. In older cows the uterine horns of the open tract may hang slightly over the pelvic ridge. As pregnancy advances and the cervix and uterus move over the ridge and into the body cavity, the palpator will have to feel past the ridge and downward.

5. DETERMINING STAGES OF PREGNANCY

a. 30-Day Pregnancy - Determining pregnancy at this early stage takes a great amount of skill and practice. Palpation at this stage should be accompanied by good breeding records so that the palpator can check the breeding dates of the animals.

In a 30-day pregnancy the uterus will be filled with fluid and feel slightly thinner. One of the horns will be enlarged a little more than the other. By running each horn between the fingers the enlargement in one horn can be felt. This enlargement is the embryonic vesicle. The vesicle is about 3/4 inch in diameter and filled tightly with fluid. It has much the same feel as a balloon filled with water. On the same side as the enlargement may be found a corpus luteum on the ovary. The corpus luteum will be a hard teat-like projection on the surface of the ovary. At this stage of pregnancy, the reproductive tract will still lie on the floor of the pelvis.



b. 45-Day Pregnancy - The embryo attaches to

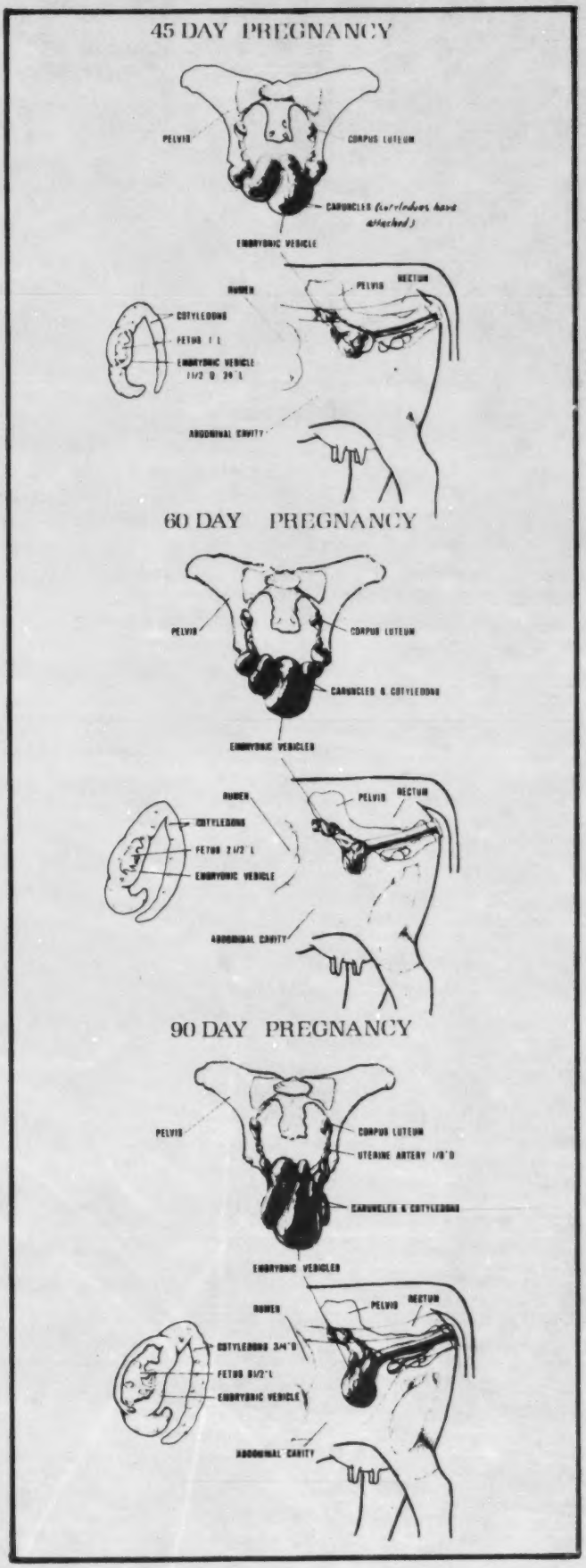
the uterine wall around the 38th day. From this time on it is called a fetus.

In this stage the fetus is about one inch long. The vesicle around it has become somewhat egg-shaped and measures one to one and one-half inches in length. The uterine horn containing the fetus has become larger and thinner walled. The vesicle membranes are beginning to attach themselves to the caruncles on the uterine wall. Therefore, the palpator should take care not to move the fetus about in the uterus. Excessive movement at this time could break the attachments and cause the death of the fetus.

c. 60-Day Pregnancy - The uterus has now enlarged until one horn is about the size of a banana and measures 8 to 10 inches long. The weight of the fetus and other contents has pulled the uterus over the pelvic ridge into the body cavity. The fetus measures 2 1/2 inches in length, and the embryonic vesicles are still prominent. The best method of feeling the fetus at this stage is to gently tap the uterus with your hand. This will cause the fetus to swing back and forth and bump against the embryonic vesicles and uterine walls. The bumping can be felt by the palpator. In this stage the cervix is still in the pelvic cradle, and the ovaries are suspended rather high in relation to the uterus. The corpus luteum will again be found on the ovary corresponding to the enlarged uterine horn.

d. 90-Day Pregnancy - The uterus in this stage is considerably larger because of increased fluid and fetal growth. The fetus is now about 6 1/2 inches long and is located on the floor of the body cavity. The cervix may be pulled over the pelvic ridge into the body cavity. The stretched uterus has pulled the ovaries down so that they may be palpated on either side of the uterus.

Because of the low position of the uterus, palpating the fetus in this stage may be difficult. The palpator may have to consider other factors to confirm pregnancy. The palpation of the uterine artery may be used to accomplish this. This artery, which carries blood to the developing fetus, is located in the forward fold of the ligament that supports the uterus. At this stage it is 1/8 to 3/16 inch in diameter and has a characteristic "whirring" pulsation as the blood moves through it. It can be felt by pressing it against the left forward side of the pelvis.



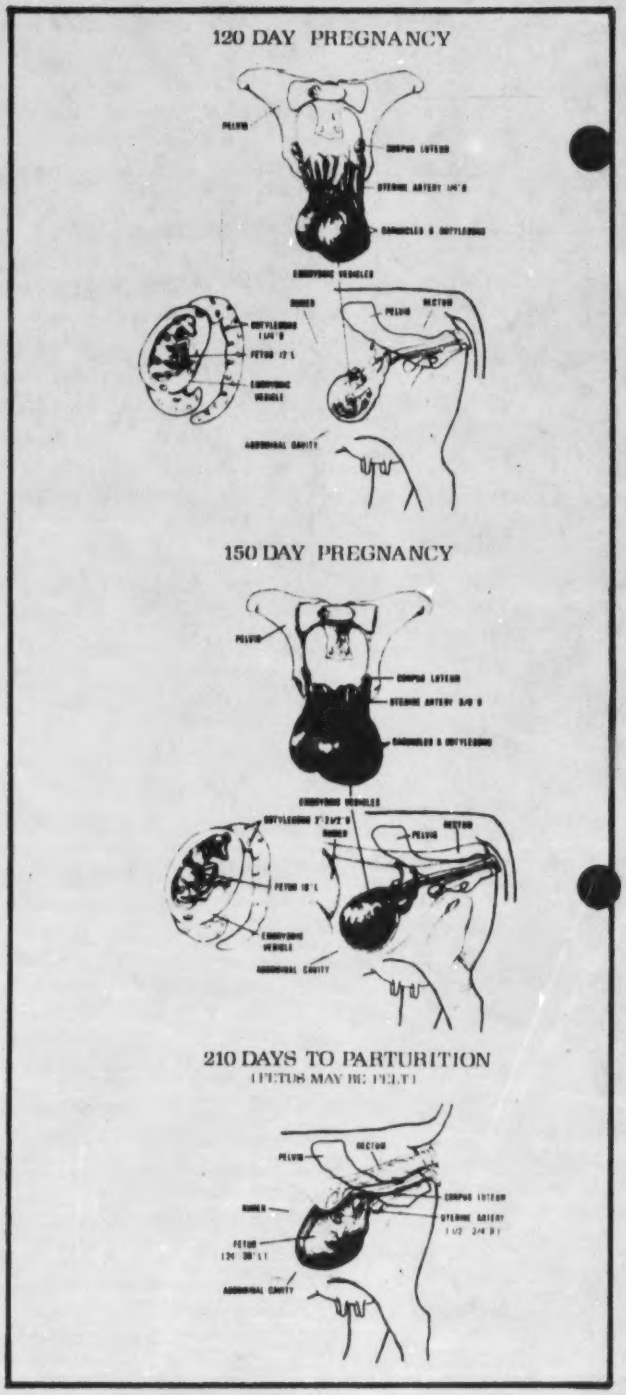
Care must be taken not to confuse the femoral artery, which lies in the muscle of the thigh. To confirm the presence of the uterine artery, attempt to move it from side to side. The femoral artery cannot be moved and does not have the "whirring" pulsation of the uterine artery. Perhaps the best indication at this time (in the absence of the fetus) is the presence of the cotyledons on the uterus. They may be felt as flattened, egg-shaped masses on the uterus. They will feel slightly firmer than the uterus and will measure 3/4 to 1 inch across.

e. 120-Day Pregnancy - The fetus in this stage is 10 to 12 inches long and is still on the floor of the body cavity. The head of the fetus is about the size of a lemon and may be the first portion of the fetus that the palpator touches. Since the fetus is larger in this stage, it is normally easier to locate. The cotyledons have enlarged to about 1 to 1 1/2 inches in length, and the uterine artery has increased in size.

f. 150-Day Pregnancy - The main change from this stage until birth is in the increased size of the fetus. At 150 days the fetus is the size of a large cat. The uterine artery is 1/4 to 3/8 inch in diameter, and the cotyledons are 2 to 2 1/2 inches in diameter. Palpation of the fetus may still be difficult because of its low position in the body cavity.

g. 180-Day Pregnancy - At this stage the fetus is still deep in the body cavity. The uterine artery is 3/8 to 1/2 inch in diameter, and the cotyledons are larger. From 180 days until birth the fetus can be made to move by grasping the feet, legs, or nose.

h. Over 7-Month Pregnancy - From 7 months until calving, the fetus may be easily felt because of the increase in fetal size.



6. AREAS OF CONFUSION IN PALPATION

The following areas may cause the beginning palpator to become confused or miscalculate pregnancy:

a. The Paunch (Rumen) - This portion of the digestive tract may be felt just after the initial thrust into the rectum. It is directly forward and to the left and when full of feed, has a firm, plastic feel. It may have the shape of the end of a football. When pressed an indentation will form which slowly fills back in and smooths over. The paunch is often mistaken for pregnancy under careless examination.

b. Pyometra - This condition may often be confused with early pregnancy. Pyometra is caused when there is an infection in the uterus and white blood cells form to combat the disease organism. The uterus may be fluid to the touch or be somewhat solidified, depending on the stage of the infection.

Palpating for cotyledons and the uterine artery will prove or disprove pregnancy.

c. Large Uterus - After a cow has calved several times, her uterus may not return to normal size. The uterus may be over the pelvic ridge as in a 3- or 4-month pregnancy. Careful palpation will show an absence of uterine fluids and cotyledons.

d. Enlarged Cervix - At times, in Brahman or Brahman crossbred cattle, a cervix that is large and has the feel of a developing fetus may be found. Careful tracing of the reproductive tract will distinguish between the two.

e. Bladder - The bladder, when full, has the feel of a 60- to 75-day pregnancy. Careful palpation will show the bladder to be a single body with no horns, as is the case with the uterus.

7. SUMMARY

The key to accurate palpation is experience. While the cow herd is being palpated is a good time to cull cows for other reasons. Cows that are slow to conceive, calve late, and produce unthrifty calves should be culled.

Palpation accuracy can usually be increased by removing all bulls from the herd 45 days before palpating. This will allow the pregnancies to develop to a stage at which pregnancy diagnosis will be easier. Remember also to keep good breeding records as an aid to the palpator.

GLOSSARY OF TERMS

1. Corpus luteum - After ovulation occurs the follicle which ruptures becomes a depression on the ovary known as a corpus luteum. If pregnancy occurs it will persist throughout the term and produce the hormone progesterone which keeps another follicle from maturing and causes development of the mammary system.

2. Embryonic vesicle - After fertilization occurs and the embryo begins developing it is contained in a thin membrane filled with fluid known as the embryonic vesicle. It serves to protect the embryo and nourish it until it attaches and becomes a fetus.

3. Femoral artery - An artery of the hind limb that lies in the muscle tissue. It is sometimes confused with the uterine artery in palpation. It is easily distinguished because it cannot be moved.

4. Follicle - On the ovaries the follicles contain the immature ova or eggs. During each heat period one or more of these matures and ruptures at ovulation. It also produces the female hormone estrogen.

5. Ovum - Female sex cell or egg.

6. Palpation - The procedure of feeling of the reproductive tract through the rectum.

7. Rectum - The anus or opening of the intestinal tract.

SELECTED STUDENT ACTIVITIES

1. What is the importance of palpation in cattle?

2. Why are breeding records beneficial to the palpator?

3. What equipment is used in palpation?

4. Why is a 60-day pregnancy hard to determine without records?

5. Schedule a field trip to a local ranch, auction sale, or other facility and practice palpating some cattle.

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ARTIFICIAL INSEMINATION

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

1. HISTORY OF ARTIFICIAL BREEDING

Artificial insemination (A. I.) is the deposition of spermatozoa in the female genitalia* by artificial rather than by natural means. The first recorded scientific research in artificial insemination of domestic animals was done with dogs by an Italian physiologist in 1780. By the late 1800's American veterinarians employed its use to get mares in foal that had persistently failed to settle to natural service. Artificial insemination was first used on a large scale by the Russians to reestablish the livestock industry following its depletion in World War I, and the British used it for the same purpose following World War II. Today it is used extensively in the U.S. in many species of livestock. However, the greatest use of artificial insemination is in the dairy industry.

2. BENEFITS FROM USING ARTIFICIAL INSEMINATION

a. Maximum Use of Outstanding Sires - Since individuals can sire many more offspring more critical selection of sires can be used. As an example, through A. I. a bull can be bred to more than 100,000 cows whereas the average for natural service would be closer to 200 cows in the lifetime of a bull.

b. Increased Uniformity - A. I. makes possible the development of large numbers of animals within a superior family thus providing uniformity and giving a better basis for a constructive breeding program.

c. Possible to Overcome Certain Handicaps - A. I. permits mating of animals of greatly different sizes (use of heavy mature bulls on heifers) and allows for the use of crippled sires that are unable to perform natural service. May help overcome geographical, environmental, or some physical limitations in hybridization.

d. Decreases Sire Cost - In most herds A. I. is less expensive than the ownership and maintenance of a top sire.

e. Reduces the Costs and Delays of Using Infertile Sires - Since A. I. sires are constantly checked the chance of using a low fertility or infertile male is unlikely.

f. Better Health Protection - A. I. stops venereal contact. Reproductive problems in individual females are more easily detected.

g. Improved Herd Records - The sires and breeding dates of each offspring are known. Thus improved culling and management result from closer herd records and observations.

h. Increases Profits - The offspring from better sires are usually more profitable.

I. Increases Pride of Ownership - The pride of ownership of offspring from outstanding sires is inevitable.

*Underlined terms are in the Glossary of Terms.

3. LIMITATIONS OF ARTIFICIAL INSEMINATION

a. **Requires a Skilled Technician** - Proper training and experience are essential to be successful with artificial insemination.

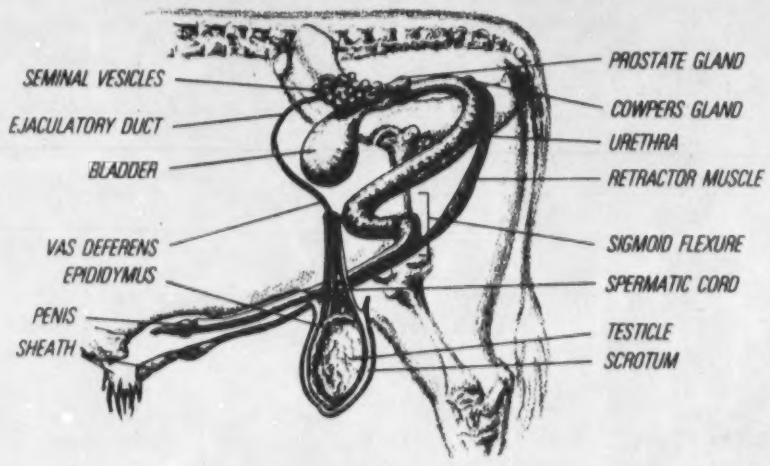
b. **May Be Subject to Certain Abuses** - Since it is impossible to differentiate between the semen of individuals of the same species the integrity of technicians and sire collection agencies is very important.

c. **May Accentuate the Damage from a Poor Sire** - Since a greater number of offspring is available through A. I. an inferior sire can increase his negative influence.

d. **Requires Additional Capital and Management** - Due to the extra handling for palpation and insemination of each individual, extra labor and facilities are usually required.

4. THE ANATOMY AND FUNCTION OF THE MALE IN ARTIFICIAL INSEMINATION

Before the best use can be made of artificial insemination as a production and management tool it is necessary to understand the function of the male reproductive tract.



The reproductive organs of the bull consist of the testicles and epididymides (carried in the scrotum), vas deferens, ampullae, urethra, accessory glands, and penis. The testicles produce the sperm cells and the male sex hormone, testosterone. The male hormone causes the development of male characteristics such as the heavy neck and shoulders and the deep voice of a bull.

The formation of sperm cells takes place in very small tubes in the testicles. Normally the testicles are found suspended in the scrotum. By raising or lowering the testes, the scrotum provides a relatively constant temperature (lower than that of the body) which is essential for sperm production. Sperm produced in the testes pass into the coiled tube, or epididymis, that lies along the back side of the testicle. The epididymis serves as a storehouse where millions of sperm mature, or ripen, so they are capable of fertilizing an egg. At the time of mating, ejaculation, sperm are carried from the epididymis through the long, slender tube--the vas deferens--which connects the epididymis from each testicle with an ampulla. The ampullae are thickened areas of the vas deferens found high in the body cavity near the point where the two join the urethra. From the ampullae, sperm pass into the urethra, the common passageway for both semen and urine.

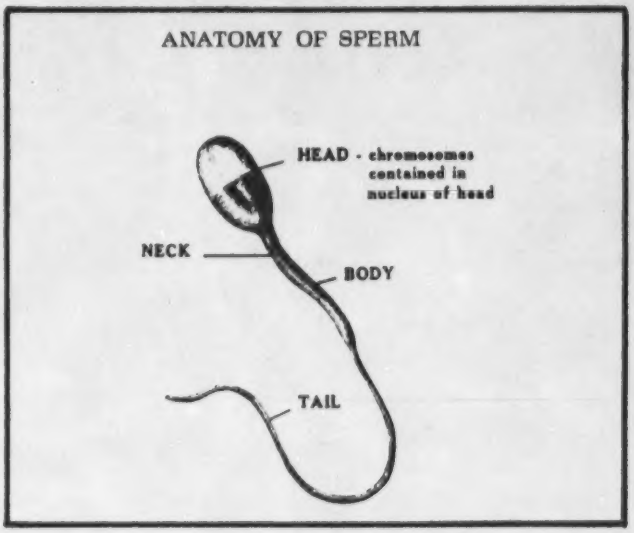
Near the point where the urethra and ampullae join are found the accessory glands called the seminal vesicles and the prostate. A short distance to the rear along the urethra is another pair of accessory glands, the Cowper's glands. Fluids from all of these accessory glands are added to the sperm from the testicles at the time of ejaculation. These fluids help transport the sperm, supply the proper environment to help keep the sperm alive, and even cleanse the urethra prior to the time that the sperm pass.

The urethra continues from high in the body (just below the rectum) through the penis to the exterior. Semen follows this path at the time of ejaculation. The penis of the bull, ram, and boar is constructed with an S-shaped curve in it. At the time of erection and mating, this S-shaped curve straightens out, thus enabling the penis to be extended to deposit semen in the vagina of the female.

5. SEMEN; COLLECTING, PROCESSING, AND STORAGE

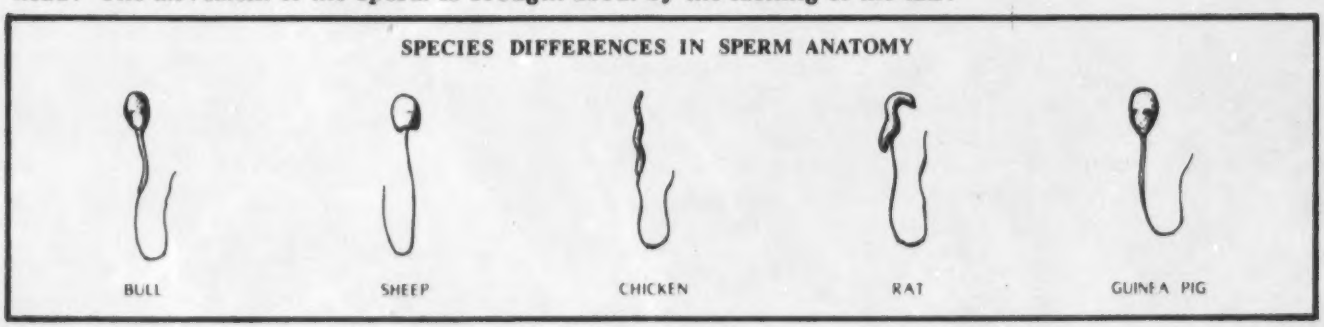
Semen is an opaque, whitish fluid discharged by the male at the time of mating. There are considerable differences in individuals and species in semen volume and sperm numbers. They are influenced by age, season of year, general health, and sexual activity of the male. The ram is capable of repeated service without noticeable decline in volume and sperm concentration. In boars and stallions, service rates higher than twice daily usually affect semen quality.

The semen consists of fluid part and a cellular part. The cells are the male reproductive cells of sperm cells and are produced by the testes. The fluid portion of the semen consists of secretions from the various glands in the reproductive tract of the male.



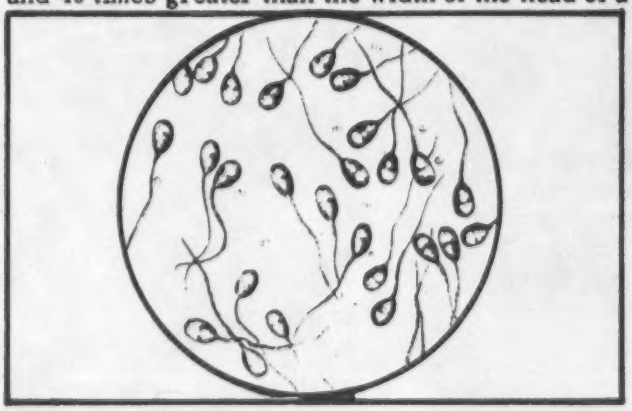
The sperm cells are microscopic in size and when observed under the microscope, they appear much like miniature tadpoles as they swim by their tails. Normal sperm consist of a head, a neck, a body, and a tail portion. The head in profile is flattened but, as seen under the microscope, is rounded or oval. It consists chiefly of nuclear material and is covered by a thin layer of cytoplasm. The head is of great importance because it contains the chromosomes (genetic materials).

The neck is very short and contains the anterior centrosome. The body is about the same length as the head. The movement of the sperm is brought about by the lashing of the tail.



Although there are minor differences in size, all spermatozoa are extremely small. A cow egg or ovum has a diameter approximately 20 times greater than the length and 40 times greater than the width of the head of a bull sperm cell.

This illustration was taken from microphotographs of the sperm of a bull with a good breeding record. Cows bred to this bull required about 1.25 services per conception. Notice the uniformity and fullness of the heads. The tails appear normal, permitting vigorous motility of the sperm after it has been introduced into the female genitalia.



The second illustration shows sperm of a bull with a poor breeding record. The heads appear normal in size and shape, but it contains many sperm with coiled tails, and a few are tailless. Only a slight rate of movement was noted and some may have appeared to have been lifeless. This bull required over 3 services per conception when used on good breeding cows.

The third illustration shows semen from a bull with a questionable breeding record. The sample contained semen with about 25 per cent abnormal sperm. It had good motility and fair viability. The service ratio was about 2.5 services per conception.

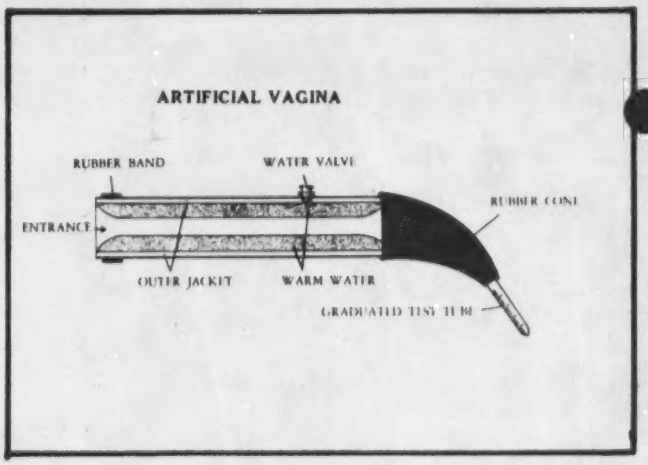
a. Collection of Semen

The method of collecting semen should be adapted to the male of the species and easy for the operator to use. It should permit the collection of a sample of normally ejaculated semen free from contamination.

(1) The Artificial Vagina

Many techniques have been developed for the collection of semen, but the most satisfactory one consists of using the artificial vagina, a Russian invention. Males usually respond to this method with little previous training. It is the most satisfactory method of collecting semen from the bull, stallion, or boar and may be used for the ram.

An artificial vagina is made of two tubes --an outer one of heavy rubber and inner lining of thin rubber. The space between the two tubes is filled with warm water. One end of the vagina is left open to permit the penis to enter. The other end leads to a graduated test tube into which the semen flows after ejaculation.



Best results are usually attained when the male is allowed to mount another animal and the penis is quickly diverted into the open end of the artificial vagina. If the vagina has been properly prepared, ejaculation is very shortly initiated.

Preparation of a bull for collection is important. A "teasing" period before collection, during which the bull may be permitted to mount the teaser animal but not ejaculate, or may be restrained from mounting although he desires to do so, results in an improvement in the quantity and quality of semen produced. At collection, as the bull mounts a cow, a steer, or a dummy, his sheath is grasped and the penis quickly guided into the artificial vagina. If the proper technique, temperature (110° to 130° F), pressure, and lubrication have been observed, the bull will ejaculate immediately. The average semen volume per ejaculate is 8-10 cc., containing on the average 8 to 15 billion sperm.

The graduated test tube in which the semen has been collected from the artificial vagina is taken to the processing laboratory as soon as the collection is finished. The test tube itself indicates the volume of semen collected.

(2) Electrical Stimulation

Collecting semen by electrical stimulation has been used on rams for several years. Only since 1950, however, has the method been put to use with bulls. The use of the electro-ejaculator has overcome many of the difficulties experienced in using other methods for testing range

bulls. If a bull is restrained properly in a good chute, semen can be collected with this machine regardless of the bull's disposition.

The electro-ejaculator was developed to produce an electrical impulse to stimulate the nervous system supplying the reproductive tract, causing erection and ejaculation.

Electrodes are inserted into the rectum of the bull after the feces have been flushed out with a salt solution. Low-power stimulations given intermittently should be increased gradually to obtain extension and erection prior to ejaculation. The first fluid that passes is a clear, watery secretion from the accessory glands which contains few, if any, sperm cells. Following this, the ejaculate turns into a milky fluid consisting of sperm and accessory fluids. A collection is made at this time for evaluation. The collection is made in a test tube attached to a flexible plastic funnel which reduces breakage and injury. The reproductive organs should be examined for abnormalities at the time of testing.

(3) Massage of the Ampullae

This method requires a well-trained operator who inserts the hand into the rectum and massages the ampullae and accessory glands, causing semen to drip from the sheath. Semen collected by this method is of poor quality, because it may be contaminated with urine and may contain too much accessory gland secretion for the number of sperm present. This system has been used successfully with bulls and stallions.

(4) Recovery of Semen from the Vagina

Natural service is first allowed. Then the semen in the anterior vagina is aspirated into a syringe by means of a glass or rubber catheter that is introduced into the vagina. Semen collected in this way is usually contaminated with the secretions of the female, and there is greater danger of spreading disease. Some operators prefer this method with sheep. It cannot be used with swine.

b. Semen Processing

(1) Testing of Semen

The thickness, or density, of the semen is tested in a photelometer which estimates the number of sperm by means of a photelometer cell.

Next, the semen is examined under a microscope. A drop of fresh semen is placed on a glass slide. The observer notes what percentage of the sperm in the sample move. If 80 percent or more of the sperm move, the "percent motility" is excellent; 70 percent is good; 50 to 60 percent fair. Rapid forward movement is desirable.

Another characteristic to check for is the morphology or the appearance of abnormal sperm.

Semen samples may be examined with the naked eye to determine its quality, but with much less quality.

(2) Extending Semen

Millions of sperm are ejaculated by the male at the time of mating. In natural mating, all these sperm are used to breed one female, even though only one sperm of the millions fertilizes the egg. An ejaculation of the male can now be extended or diluted so that many more females can be bred with it. This is accomplished by adding materials to the semen which help to keep the the sperm alive and at the same time give the sample more volume.

Some of the more common diluters and the classes of livestock for which they are used are shown in the following table.

SEMEN DILUTERS

Type of Diluter	Classes of Animals Used For	Comments
1. egg yolk-citrate	bull, ram	1 part fresh egg yolk to 3 parts 2.9% sodium citrate dihydrate in distilled water
2. egg yolk-phosphate	bull, ram, stallion	mix equal parts of fresh egg yolk and chemically pure sodium hydrophosphate-hydrate (appropriate phosphate solution)
3. homogenized whole milk	bull, ram, boar	boil fresh homogenized whole milk for 5 to 10 minutes, then cool to body temperature and dilute with equal parts of distilled water
4. glycine-containing diluents	boar	formula-50% of a 4% glycine solution, 42.5% skim milk, and 7.5% egg yolk

Antibacterial agents are added to the extenders to help control bacterial growth. Antibacterial agents commonly used are: Sulfanilamide - 3 milligrams per cc final diluent; Penicillin - 500 units per cc final diluent; Streptomycin - 500 micrograms per cc final diluent.

In order to keep sperm alive, it is important that the diluents be added a few minutes after the semen is collected from the male. It is also important that sperm never be cooled suddenly. They can withstand slow cooling, but cold shock is extremely harmful. Thus, the semen and diluent should always be near the same temperature.

Semen that is undiluted will not live much over 24 hours at room temperature. By adding diluents and slowly cooling the semen to refrigerator temperature, 41° F, the sperm may frequently be kept fertile for nearly a week, and active movement can be maintained for 20 to 30 days. The reduced temperature slows the sperm until it is inactive; thus its energy is saved.

c. Storing Semen

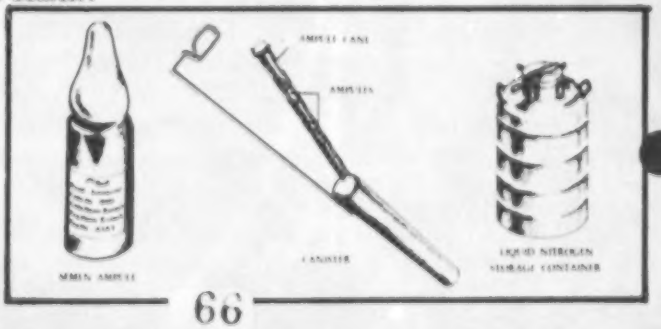
(1) Preparations for Storage

After special treatment of semen with the selected extender, the sperm can withstand freezing to extremely low temperatures. Usually the semen is collected and diluted in the manner already discussed. After it is cooled, a 7 to 10% glycerol solution is added slowly over a one-half hour period. The sperm are then allowed to stand in the refrigerator for 6 to 18 hours.

(2) Ampuling

The basic unit for semen storage and shipment is an individual glass ampule, containing just enough semen for a single insemination. After the semen has been collected and evaluated, glass ampules are prepared to receive the semen.

Each individual ampule is identified with the sire's name and registration number, breed, a code number, and identification as to the specific collection. The filling and sealing operations are done in refrigerated rooms maintained at 40° F. Careful attention is given to the volume of semen in each ampule and to the quality of seal.



Volume of Semen and Concentration Per Insemination

Species	Semen Dilution Ratio	Volume of Semen Needed Per Service	No. Sperm Per Insemination
Bull	1:200	*1 cc	15 million
Stallion	----	5-10 cc	250 million
Boar	1:8	50-100 cc	2 million
Ram	1:1	*1 cc	50 million

*1 cc is the volume of semen contained in each ampule of bull and ram semen.

After filling and sealing, each ampule is clipped, one above another, to a metal holding device called a rack. This provision for vertical storage makes it possible to store many ampules of semen in a very compact space.

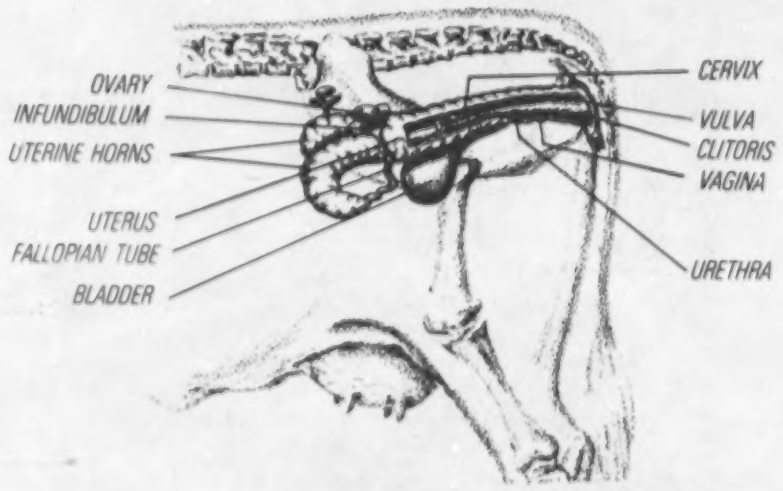
(3) Freezing and Storage

Finally, by using liquid nitrogen or dry ice in an alcohol bath, the diluted semen with the glycerol added is slowly frozen. When maintained at -110° F (dry ice) or -320° F (liquid nitrogen) until needed for breeding, semen will stay fertile and can be stored for months or perhaps years. It is important that the low storage temperature be maintained constantly; otherwise, the sperm will die.

The technician has the responsibility of handling the frozen semen in order to preserve its quality. Most technicians store the ampules of frozen semen in a liquid nitrogen container (refrigerator) such as the one illustrated. This particular liquid nitrogen container holds up to 480 ampules and may be safely stored for as long as 60 days.

6. THE ANATOMY AND FUNCTION OF THE FEMALE IN ARTIFICIAL INSEMINATION

In order to become competent with artificial insemination it is necessary to understand the anatomy of the female reproductive system and how it functions.



The main purpose of the female reproductive system is to produce the eggs or ovum to be fertilized by the sperm to form the embryo. It serves as a receptacle for the male penis during copulation and houses and nourishes the fetus until parturition.

There are two ovaries which function to produce eggs or ova from numerous follicles located on their surfaces. They also produce the female hormones estrogen and progesterone which regulate the heat cycle and

maintain pregnancy. Just below the ovaries there are two funnel-like openings to the oviducts called the infundibulums which pick up the eggs at ovulation and direct them into the fallopian tubes which is the passageway for the eggs into the uterine horns. In one of the horns is where the embryo usually attaches to the uterine wall to be nourished and developed until parturition. The body of the uterus is where the horns join, and it is separated from the vagina by the cervix. The cervix is a mass of concentric muscles with a small tube-like opening which joins the vagina and uterus. It serves as a passageway for the semen from the vagina at copulation and contains glands which secrete a waxy substance that seals off the uterus during pregnancy and between heat periods. This serves to protect against infection, disease, or foreign matter. The vagina is the receptacle for the penis during copulation. It also serves as a passageway for the expellation of liquid wastes as the urethra joins the bladder to the vagina prior to the opening at the vulva. Just inside the vulva is a sensory erectile organ called the clitoris. The vulva is the exterior opening of the female reproductive tract.

7. HEAT DETECTION AND THE IMPORTANCE OF TIMING IN ARTIFICIAL INSEMINATION

a. How to Find Cows in Heat

Successful, practical artificial insemination requires that a man's judgment be substituted for a bull's instinct. Should the man be less diligent or conscientious in the task of detecting cows in heat than a bull, the time when some cows are in heat will surely be missed, and they will pass out of heat un-inseminated.

Cows in heat are under the influence of a sudden, high-level occurrence of female sex or "heat" hormone (estrogen). The egg-containing follicle which produces the hormone is at the height of its growth.

The nervous system is greatly affected. The cow is excitable and may do an unusual amount of bawling. She is restless and often walks the fences. The herdsman who knows his cows well can often recognize heat by the alert, bright-eyed, nervous appearance shown by cows during this period.

Cows in heat attempt to ride other cows. They stand to be mounted by other cows. Under conditions of natural service, they would stand and accept service by a bull. Standing is the only reliable, practical test for heat. When a cow stands she is in heat and is ready for service.

Ruffled hair over the tail head suggests that a cow has recently been ridden; she may or may not have been in heat. When cows "sniff around" one another, such is a common sign that one is approaching or is in early heat. Riding follows. Then--the cow in heat stands.

Many heifers and cows in heat flatten themselves down in the loin region. This presents a "sway back" and "high tail bent" appearance.

The heat hormone from the ovary also has an effect upon the genital organs. Genital mucous becomes greater in quantity and thinner in quality. It may even flow from the vulva in long strings. Wet mucous smears are often noticeable on the buttocks, over the pin bones, and under the tail.

The vulva of a cow in heat appear somewhat swollen. The skin becomes more moist and less wrinkled. The fine hairs stick together because they are wet. The vulva of the cow when not in heat appear sunken. The skin is dry and in tiny folds and wrinkles.

The second or third day after heat, but sometimes earlier, bloody mucous passes from the cow's vulva. This may be noticed smeared on the buttocks or tail or, after lying down, in a pool behind the cow. Bleeding from the cow means that she has been in heat (ovulation implied) 2 or 3 days before. Whether a cow bleeds or does not bleed after heat has nothing to do with whether she has conceived or has not conceived from service or insemination at that heat.

Similar conditions to some of those described for finding cows in heat may be observed in other classes of farm animals.

b. Heat Detection Procedures

The herd management conditions determine the exact procedures to be followed in observing the individuals of a herd for signs of heat. This should be done at least twice each day. Animals in pasture must be carefully observed. A record-keeping system which tells when particular animals require watching helps in detecting females in heat. Adequate pens and holding facilities are very important in an A. I. program.

c. The Importance of Timing in Artificial Insemination

It must be understood that the female is fertile only when an egg is present which can be fertilized. Likewise, it must be understood that an egg can live only a short time after being released from the ovary unless it is fertilized.

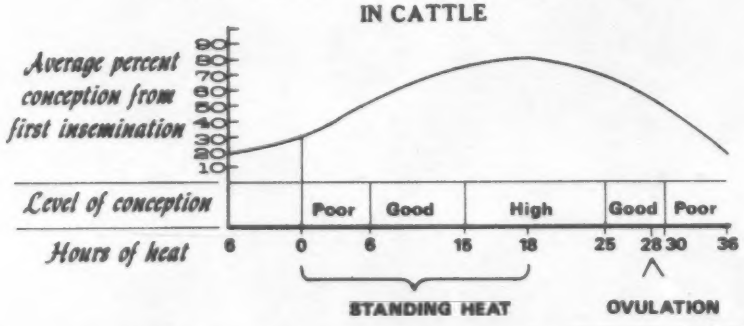
THE REPRODUCTION CYCLE IN FARM ANIMALS

Species	Length of Estrus Cycle (days)		Length of Estrus		Usual Time of Ovulation	Length of Gestation (days)		Age at Puberty (months)
	av.	range	av.	range		av.	range	
mare	21	10-37	5-6 days	1-14 days	24-48 hrs. before end of estrus	336	310-350	10-12
cow	19-21	16-24	16-20 hrs.	8-30 hrs.	10-14 hrs. after end of estrus	281	274-291	4-8
ewe	16	14-20	30 hrs.	20-42 hrs.	1 hr. before end of estrus	150	140-160	4-8
sow	21	18-24	1-5 days	1-5 days	18-60 hrs. after estrus begins	112	111-115	5-7

The optimal time for insemination is in advance of the time of ovulation, which varies according to species. This is so that the sperm will have ample time to migrate to the oviducts by the time the egg arrives. This time differs among species.

Mares normally ovulate 24 to 48 hours before the termination of the heat period, cows about 10 to 12 hours after the end of heat, ewes near the end of heat, and sows about 30 to 40 hours after the beginning of heat period. Thus a mare with a 5-day heat period should be inseminated on the third day and at least every other day thereafter for the duration of heat. Cows should be inseminated during the latter half of the heat period, ewes during the last day of heat, and sows 12 to 24 hours after the beginning of heat. In sows, a second service 12 to 24 hours later increases conception and litter size.

TIME OF BREEDING AND CONCEPTION RATE IN CATTLE



Some of the factors which will affect conception rate should be considered in an artificial insemination program.

(a) For highest conception rates in cattle, breed 60-90 days after calving.
(b) Best results are obtained if cattle are bred during the period of from 6 hours following heat to 2 hours after heat.
(c) Sperm will live about 24 hours in the female reproductive tract.
(d) True heat is demonstrated in cattle when a cow will stand for others to ride her.
(e) Fertilization will occur immediately if sperm is present when the egg is released.

8. THE INSEMINATION OF THE FEMALE

Cleanliness during all insemination manipulations is essential and is the crucial point for success or failure. This applies to the instruments used, to the hands of the operator, and to the animals.

a. Preparing the Semen

(1) Care should be taken in handling the semen ampules since exposure of frozen semen samples to air for over 20 seconds may lower the fertility of the semen.

(2) Always wear gloves in handling frozen semen. The hazard of frostbite is not great, but it can happen. Some ampules, because of a faulty seal, explode rather violently and throw shattered glass in all directions.

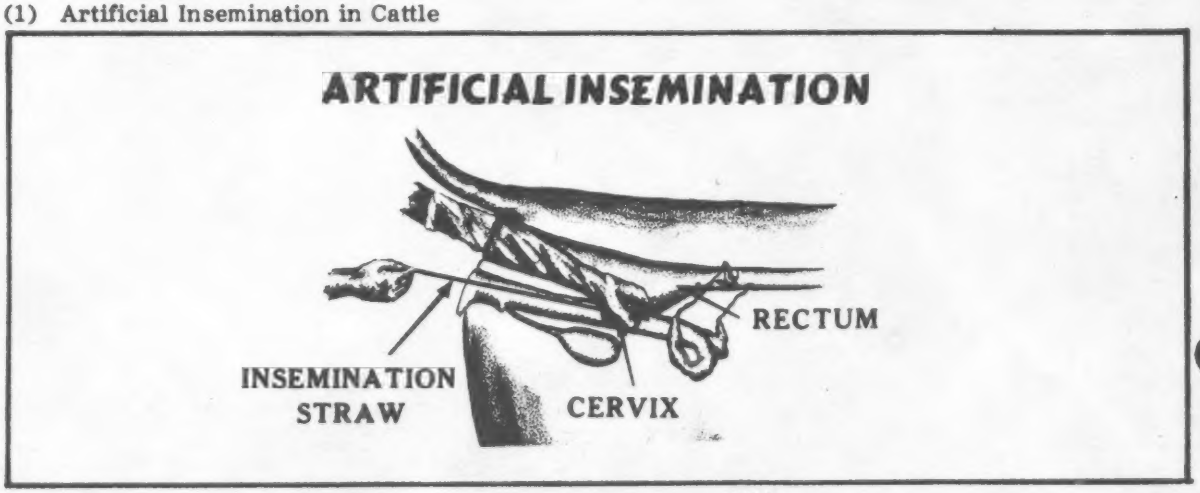
(3) Thaw water should be between 32° to 40° F (iced water), and the semen ampule should be put into the thaw water with not more than ten seconds exposure to air.

(4) Frozen semen can be warmed rapidly without harm as long as the temperature does not rise above that of the body. There is less danger of cold shock when thawed slowly in iced water, but thawing and holding ampules in ice water for several hours is not recommended.

b. Inseminating Technique

The procedures used in artificially inseminating female farm animals vary with the species involved. The cow and ewe have cervixes which are rather tightly closed. With these two, the cervix must be seen or grasped with the hand in order to insert the inseminating tube. In the mare and sow, the cervix is more open and will admit an inseminating tube more easily. In the smaller animals it is difficult or impossible to insert a gloved hand into the rectum to guide an inseminating tube. Thus the sow with an open cervix can be inseminated simply by directing the tube into the vagina and carefully working it forward into the cervix. In the ewe, a speculum can be used to hold the walls of the vagina out so the opening of the cervix can be seen with a flashlight. The speculum method can be used on larger animals also.

(1) Artificial Insemination in Cattle



The rectovaginal technique can be used with cows and mares. In this method, one hand covered with a rubber glove or disposable plastic glove-sleeve is inserted into the rectum. Most inseminators prefer to use the left hand for manipulation of the cervix through the rectal wall and the right hand for directing and controlling the inseminating tube.

The human hand working within the rectum must respect the physical makeup of the tissues and organs that are contacted. The technician must realize that serious damage will be done to the rectal wall, ovaries, or uterus when these structures are improperly handled.

Lubrication of the hand and arm is very helpful. Water is usually sufficient. A simple mild lubricant such as a K. Y. Jelly or equivalent, obtainable at most drug stores, may occasionally be necessary. Soaps or detergents are not recommended as lubricants since they are sometimes irritating and may be harmful to the sperm.

The technician's hand should be entered into the rectum by holding the fingers in a coned position and inserting the hand through the anal opening. The entire hand and as much of the arm as is needed can be passed into the rectal cavity. The cervix is located and then held and manipulated through the floor of the rectum. The other hand introduces the inseminating tube (pipette) 5 to 6 mm in diameter and 40 cm long containing 1 ml (cc) of diluted semen, through the vagina. The hand within the rectum manipulates the cervix to permit the passing of the tube into the cervix.

In the cow, the semen is deposited in the cervix. The tube tip should not enter into the body of the uterus or the horns of the uterus, as it could damage the very fragile lining of that organ.

After passing the inseminating tube through the vagina and just through the cervix, depress the bulb slowly so that the semen does not adhere to the wall of the inseminating tube. Then withdraw the arm and hand slowly from the cow.

Results obtained by using the method on cattle have frequently been better than those obtained by natural mating. In natural service, the bull normally deposits the semen in the vagina next to the cervix, and the sperm apparently pass through the closed cervix with little difficulty. Presumably, contractions of the uterus, caused by the hormone oxytocin, are responsible for the quick transportation. It is believed that the sperm must be in the female reproductive tract for 4 to 6 hours to develop the capacity to fertilize an egg. Since sperm live for only about 24 hours in the female reproductive tract, the best time for insemination is between mid-heat and 6 hours after the end of heat. Breeding at this time enables the sperm to have the ability to fertilize the egg and remain in waiting in the oviduct for the egg to be released from the ovary.

Another important consideration in breeding cows is the time of rebreeding after calving. Too often the cow is given too little time to recover from the strain of carrying and delivering the previous calf. Careful studies have shown that at least 60 days should be allowed after calving before rebreeding. This is necessary to allow the reproductive tract of the cow to return to normal. When at least 60 days rest are allowed, the chances of getting the cow to conceive are better. Also, there is less chance of causing future breeding troubles.

(2) Artificial Insemination in Horses

There has been less interest in, and more resistance to, artificial insemination in horses than any other class of livestock.

Artificial insemination is not permitted by some horse breed registry associations, but extensive use is made of the practice known as "impregnation". This consists of collecting the final portion of the ejaculate as the stallion dismounts and, with a syringe and inseminating tube, injecting it through the cervix of the mare just covered, with the object being to increase the chances of conception.

In the past, horse semen was considered to be extremely fragile and satisfactory results were thought to be obtainable only when it was used within a few minutes of collection. Now it can

be stored effectively for up to 24 hours using egg yolk - glucose extenders. It has also been successfully frozen. Normally the semen collected at one service from the stallion can be extended to artificially breed about 15 mares.

For insemination, a glass syringe attached by a rubber adapter to a disposable inseminating tube is commonly used. The lubricated gloved hand containing the inseminating tube is passed into the vagina, the cervix located with the index finger, and the tube passed through the cervix. Insemination is thus made directly into the uterus. The optimum time for insemination can best be assessed by following the development of the follicle by rectal palpation. Another method is to estimate the time of ovulation from the appearance of the vagina and cervix as seen through a vaginal speculum.

It should be kept in mind that sperm are severely harmed by water, acids, soaps, metals, cold shock, and high temperatures. Thus, attempts should be made to avoid contamination of semen with any foreign materials, and careful temperature control should be maintained at all times.

(3) Artificial Insemination in Sheep

Except in Russia, the technique of artificial insemination of sheep has not passed much beyond the experimental stage. It has not found wide application in the sheep industry in the United States because the demand for it has not yet arisen. Until the problem of storage is solved, it will be necessary that semen be collected from rams when and where it is to be used.

Ewes in heat are identified by vasectomized rams carrying some suitable "marker" device on the brisket. Preferably, ewes should be inseminated during the latter half of the heat period and while the vaginal mucous is thin and clear in appearance.

For insemination, the ewe is restrained to limit movement and to present the hindquarters at a convenient height for easy access to the vagina. The cervix is located with the aid of a speculum and suitable light, and the insemination is made as deeply as possible into the cervical canal. In inseminating ewes 0.05 to 0.2 cc diluted semen containing 50 to 100 million sperm is recommended for deposition in the cervix.

(4) Artificial Insemination in Swine

Artificial insemination of swine is still in the experimental stage in the United States, but there is great interest in its potential. The techniques involved have been developed to the point where artificial insemination is reliable and technically simple.

In sows, ovulation occurs normally about 40 hours after the onset of heat. The optimum time for insemination occurs about 16 hours before ovulation and coincides with the time during heat when most gilts and sows will tolerate heavy pressure on the loin area. Inseminations performed at this time will result in a farrowing rate of about 75%, while inseminations at other times result in 30 to 40% conception rate.

At insemination a disposable plastic pipette is inserted into the cervix, keeping the pipette against the dorsal surface of the vagina. The semen is slowly forced into the uterus from a plastic squeeze or syringe. In swine, 20 to 50 cc of fresh semen diluted at a rate of 1 part of semen to 1.5 to 5 parts of diluent has given reasonable conception rates. Careful heat checks and patience during insemination are essential for good results.

9. SANITARY PRECAUTIONS AND OTHER MANAGEMENT PRACTICES THAT SHOULD BE CONSIDERED IN USING ARTIFICIAL INSEMINATION

a. Avoid breeding diseased or infected females.
b. Have males checked regularly by a veterinarian to be sure they are free of transmissible diseases.
c. Have examined by a veterinarian females which have been bred two or more times without conception.
d. Wait at least 60 days after calving to breed cows back.

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e. Mares can be bred back on foal heat (7 to 11 days after foaling) if foaling was normal and no infection occurred.
f. Sows should be bred back in 35 to 50 days.
g. All semen collection equipment should be clean and sterile.
h. Follow strict refrigeration recommendations for handling semen.

GLOSSARY OF TERMS

1. A. I. - The abbreviation for artificial insemination.
2. Aspirated - To remove by the process of suction.
3. Centrosome - A minute protoplasmic body considered to be the center of miotic (sexual division) activity.
4. Embryo - The fertilized egg up until attachment to the uterine wall when it becomes a fetus.
5. Estrogen - Female hormone produced by the ovaries which regulates the heat period.
6. Fetus - After the embryo attaches to the uterine wall and begins receiving nourishment from the mother it is called a fetus.
7. Genitalia - The organs of the reproductive system.
8. Heat cycle - The period of time when the female ovulates until next ovulation (from one standing heat until the next).
9. Hybridization - The production of offspring from two different races, breeds, varieties or species of animals.
10. Motility - Capable of movement.
11. Morphology - The study of the form and structure of plants or animals.
12. Oxytocin - Hormone which regulates the contraction of uterine muscles and ejection of milk.
13. Parturition - The act of giving birth.
14. Rectovaginal - Pertaining to the combination of the rectum and the vagina.
15. Speculum - An instrument inserted into a body passage for inspection or medication.
16. Testes - The major male reproductive glands which produce sperm.
17. Vasectomized - Surgical excision of the vas deferens to cause permanent sterility.

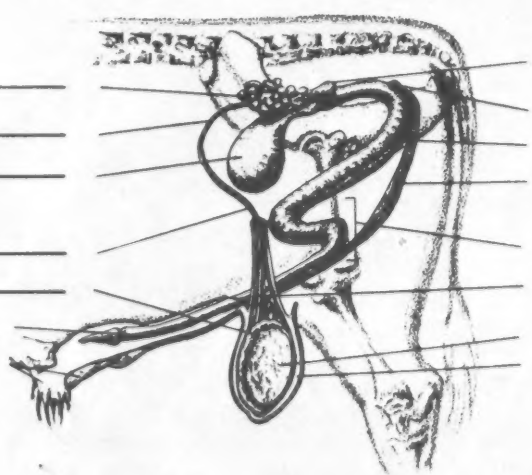
SELECTED STUDENT ACTIVITIES

1. Discuss how A. I. might be of economic importance to a livestock producer.

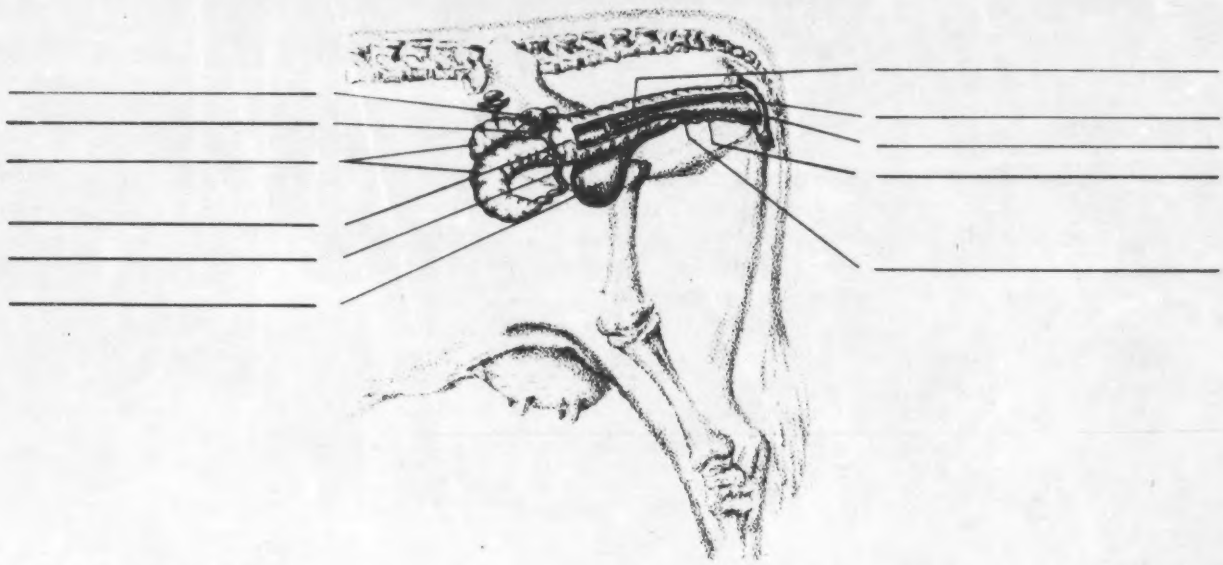
2. What is the female hormone produced by the ovary that regulates the heat period?

3. What is parturition?

4. Label the parts of the male reproductive tract in the following illustration.



5. Label the parts of the female reproductive tract in the following illustration.



6. What is a "Gomer"?

7. What is the hormone produced by the testes which causes libido and secondary male characteristics?

8. What is a semen extender?

9. Visit a farm or ranch in your community where artificial insemination is being used.

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